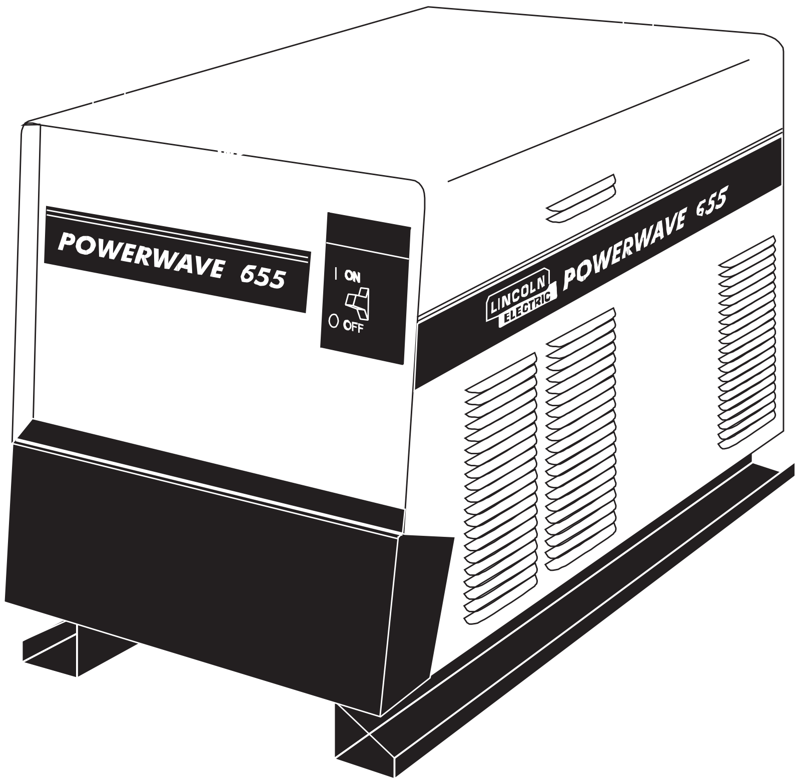
SVM180-A

January, 2008

POWERWAVE™ 655/R

For use with machines having Code Numbers: **10630, 10863, 11410**



Safety Depends on You

Lincoln arc welding and cutting equipment is designed and built with safety in mind. However, your overall safety can be increased by proper installation ... and thoughtful operation on your part. **DO NOT INSTALL, OPERATE OR REPAIR THIS EQUIPMENT WITHOUT READING THIS MANUAL AND THE SAFETY PRECAUTIONS CONTAINED THROUGHOUT.** And, most importantly, think before you act and be careful.

SERVICE MANUAL

LINCOLN® ELECTRIC

• World's Leader in Welding and Cutting Products •
• Sales and Service through Subsidiaries and Distributors Worldwide •
Cleveland, Ohio 44117-1199 U.S.A. TEL: 216.481.8100 FAX: 216.486.1751 WEB SITE: www.lincolnelectric.com

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WARNING

CALIFORNIA PROPOSITION 65 WARNINGS

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

The Above For Diesel Engines

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

The Above For Gasoline Engines

ARC WELDING CAN BE HAZARDOUS. PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. KEEP CHILDREN AWAY. PACEMAKER WEARERS SHOULD CONSULT WITH THEIR DOCTOR BEFORE OPERATING.

Read and understand the following safety highlights. For additional safety information, it is strongly recommended that you purchase a copy of “Safety in Welding & Cutting - ANSI Standard Z49.1” from the American Welding Society, P.O. Box 351040, Miami, Florida 33135 or CSA Standard W117.2-1974. A Free copy of “Arc Welding Safety” booklet E205 is available from the Lincoln Electric Company, 22801 St. Clair Avenue, Cleveland, Ohio 44117-1199.

BE SURE THAT ALL INSTALLATION, OPERATION, MAINTENANCE AND REPAIR PROCEDURES ARE PERFORMED ONLY BY QUALIFIED INDIVIDUALS.

FOR ENGINE powered equipment.

1.a. Turn the engine off before troubleshooting and maintenance work unless the maintenance work requires it to be running.



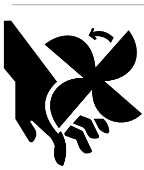
1.b. Operate engines in open, well-ventilated areas or vent the engine exhaust fumes outdoors.



1.c. Do not add the fuel near an open flame welding arc or when the engine is running. Stop the engine and allow it to cool before refueling to prevent spilled fuel from vaporizing on contact with hot engine parts and igniting. Do not spill fuel when filling tank. If fuel is spilled, wipe it up and do not start engine until fumes have been eliminated.

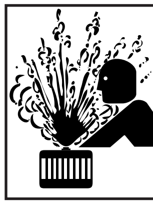
1.d. Keep all equipment safety guards, covers and devices in position and in good repair.Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts when starting, operating or repairing equipment.

1.e. In some cases it may be necessary to remove safety guards to perform required maintenance. Remove guards only when necessary and replace them when the maintenance requiring their removal is complete. Always use the greatest care when working near moving parts.

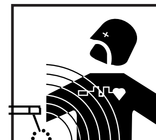


1.f. Do not put your hands near the engine fan. Do not attempt to override the governor or idler by pushing on the throttle control rods while the engine is running.

1.g. To prevent accidentally starting gasoline engines while turning the engine or welding generator during maintenance work, disconnect the spark plug wires, distributor cap or magneto wire as appropriate.



1.h. To avoid scalding, do not remove the radiator pressure cap when the engine is hot.



ELECTRIC AND MAGNETIC FIELDS may be dangerous

2.a. Electric current flowing through any conductor causes localized Electric and Magnetic Fields (EMF). Welding current creates EMF fields around welding cables and welding machines

2.b. EMF fields may interfere with some pacemakers, and welders having a pacemaker should consult their physician before welding.

2.c. Exposure to EMF fields in welding may have other health effects which are now not known.

2.d. All welders should use the following procedures in order to minimize exposure to EMF fields from the welding circuit:

2.d.1. Route the electrode and work cables together - Secure them with tape when possible.

2.d.2. Never coil the electrode lead around your body.

2.d.3. Do not place your body between the electrode and work cables. If the electrode cable is on your right side, the work cable should also be on your right side.

2.d.4. Connect the work cable to the workpiece as close as possible to the area being welded.

2.d.5. Do not work next to welding power source.

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ELECTRIC SHOCK can kill.

3.a. The electrode and work (or ground) circuits are electrically “hot” when the welder is on. Do not touch these “hot” parts with your bare skin or wet clothing. Wear dry, hole-free gloves to insulate hands.

3.b. Insulate yourself from work and ground using dry insulation. Make certain the insulation is large enough to cover your full area of physical contact with work and ground.

In addition to the normal safety precautions, if welding must be performed under electrically hazardous conditions (in damp locations or while wearing wet clothing; on metal structures such as floors, gratings or scaffolds; when in cramped positions such as sitting, kneeling or lying, if there is a high risk of unavoidable or accidental contact with the workpiece or ground) use the following equipment:

- **Semiautomatic DC Constant Voltage (Wire) Welder.**
- **DC Manual (Stick) Welder.**
- **AC Welder with Reduced Voltage Control.**

3.c. In semiautomatic or automatic wire welding, the electrode, electrode reel, welding head, nozzle or semiautomatic welding gun are also electrically “hot”.

3.d. Always be sure the work cable makes a good electrical connection with the metal being welded. The connection should be as close as possible to the area being welded.

3.e. Ground the work or metal to be welded to a good electrical (earth) ground.

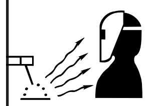
3.f. Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition. Replace damaged insulation.

3.g. Never dip the electrode in water for cooling.

3.h. Never simultaneously touch electrically “hot” parts of electrode holders connected to two welders because voltage between the two can be the total of the open circuit voltage of both welders.

3.i. When working above floor level, use a safety belt to protect yourself from a fall should you get a shock.

3.j. Also see Items 6.c. and 8.



ARC RAYS can burn.

4.a. Use a shield with the proper filter and cover plates to protect your eyes from sparks and the rays of the arc when welding or observing open arc welding. Headshield and filter lens should conform to ANSI Z87. I standards.

4.b. Use suitable clothing made from durable flame-resistant material to protect your skin and that of your helpers from the arc rays.

4.c. Protect other nearby personnel with suitable, non-flammable screening and/or warn them not to watch the arc nor expose themselves to the arc rays or to hot spatter or metal.



FUMES AND GASES can be dangerous.

5.a. Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases.When welding, keep your head out of the fume. Use enough ventilation and/or exhaust at the arc to keep fumes and gases away from the breathing zone. **When welding with electrodes which require special ventilation such as stainless or hard facing (see instructions on container or MSDS) or on lead or cadmium plated steel and other metals or coatings which produce highly toxic fumes, keep exposure as low as possible and below Threshold Limit Values (TLV) using local exhaust or mechanical ventilation. In confined spaces or in some circumstances, outdoors, a respirator may be required. Additional precautions are also required when welding on galvanized steel.**

5. b. The operation of welding fume control equipment is affected by various factors including proper use and positioning of the equipment, maintenance of the equipment and the specific welding procedure and application involved. Worker exposure level should be checked upon installation and periodically thereafter to be certain it is within applicable OSHA PEL and ACGIH TLV limits.

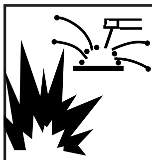
5.c. Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.

5.d. Shielding gases used for arc welding can displace air and cause injury or death. Always use enough ventilation, especially in confined areas, to insure breathing air is safe.

5.e. Read and understand the manufacturer’s instructions for this equipment and the consumables to be used, including the material safety data sheet (MSDS) and follow your employer’s safety practices. MSDS forms are available from your welding distributor or from the manufacturer.

5.f. Also see item 1.b.

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WELDING SPARKS can cause fire or explosion.

6.a. Remove fire hazards from the welding area. If this is not possible, cover them to prevent the welding sparks from starting a fire. Remember that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas. Avoid welding near hydraulic lines. Have a fire extinguisher readily available.

6.b. Where compressed gases are to be used at the job site, special precautions should be used to prevent hazardous situations. Refer to “Safety in Welding and Cutting” (ANSI Standard Z49.1) and the operating information for the equipment being used.

6.c. When not welding, make certain no part of the electrode circuit is touching the work or ground. Accidental contact can cause overheating and create a fire hazard.

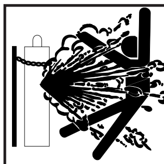
6.d. Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapors from substances inside. They can cause an explosion even though they have been “cleaned”. For information, purchase “Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances”, AWS F4.1 from the American Welding Society (see address above).

6.e. Vent hollow castings or containers before heating, cutting or welding. They may explode.

6.f. Sparks and spatter are thrown from the welding arc. Wear oil free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes and a cap over your hair. Wear ear plugs when welding out of position or in confined places. Always wear safety glasses with side shields when in a welding area.

6.g. Connect the work cable to the work as close to the welding area as practical. Work cables connected to the building framework or other locations away from the welding area increase the possibility of the welding current passing through lifting chains, crane cables or other alternate circuits. This can create fire hazards or overheat lifting chains or cables until they fail.

6.h. Also see item 1.c.



CYLINDER may explode if damaged.

7.a. Use only compressed gas cylinders containing the correct shielding gas for the process used and properly operating regulators designed for the gas and pressure used. All hoses, fittings, etc. should be suitable for the application and maintained in good condition.

7.b. Always keep cylinders in an upright position securely chained to an undercarriage or fixed support.

7.c. Cylinders should be located:
- Away from areas where they may be struck or subjected to physical damage.
- A safe distance from arc welding or cutting operations and any other source of heat, sparks, or flame.

7.d. Never allow the electrode, electrode holder or any other electrically “hot” parts to touch a cylinder.

7.e. Keep your head and face away from the cylinder valve outlet when opening the cylinder valve.

7.f. Valve protection caps should always be in place and hand tight except when the cylinder is in use or connected for use.

7.g. Read and follow the instructions on compressed gas cylinders, associated equipment, and CGA publication P-l, “Precautions for Safe Handling of Compressed Gases in Cylinders,” available from the Compressed Gas Association 1235 Jefferson Davis Highway, Arlington, VA 22202.



FOR ELECTRICALLY powered equipment.

8.a. Turn off input power using the disconnect switch at the fuse box before working on the equipment.

8.b. Install equipment in accordance with the U.S. National Electrical Code, all local codes and the manufacturer’s recommendations.

8.c. Ground the equipment in accordance with the U.S. National Electrical Code and the manufacturer’s recommendations.

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PRÉCAUTIONS DE SÛRETÉ

Pour votre propre protection lire et observer toutes les instructions et les précautions de sûreté specifiques qui parraissent dans ce manuel aussi bien que les précautions de sûreté générales suivantes:

Sûreté Pour Soudage A L'Arc

1. Protegez-vous contre la secousse électrique:

   a. Les circuits à l'électrode et à la piéce sont sous tension quand la machine à souder est en marche. Eviter toujours tout contact entre les parties sous tension et la peau nue ou les vétements mouillés. Porter des gants secs et sans trous pour isoler les mains.
   b. Faire trés attention de bien s'isoler de la masse quand on soude dans des endroits humides, ou sur un plancher metallique ou des grilles metalliques, principalement dans les positions assis ou couché pour lesquelles une grande partie du corps peut être en contact avec la masse.
   c. Maintenir le porte-électrode, la pince de masse, le câble de soudage et la machine à souder en bon et sûr état defonctionnement.
   d. Ne jamais plonger le porte-électrode dans l'eau pour le refroidir.
   e. Ne jamais toucher simultanément les parties sous tension des porte-électrodes connectés à deux machines à souder parce que la tension entre les deux pinces peut être le total de la tension à vide des deux machines.
   f. Si on utilise la machine à souder comme une source de courant pour soudage semi-automatique, ces precautions pour le porte-électrode s'applicuent aussi au pistolet de soudage.

2. Dans le cas de travail au dessus du niveau du sol, se protéger contre les chutes dans le cas ou on recoit un choc. Ne jamais enrouler le câble-électrode autour de n'importe quelle partie du corps.

3. Un coup d'arc peut être plus sévère qu'un coup de soliel, donc:

   a. Utiliser un bon masque avec un verre filtrant approprié ainsi qu'un verre blanc afin de se protéger les yeux du rayonnement de l'arc et des projections quand on soude ou quand on regarde l'arc.
   b. Porter des vêtements convenables afin de protéger la peau de soudeur et des aides contre le rayonnement de l'arc.
   c. Protéger l'autre personnel travaillant à proximité au soudage à l'aide d'écrans appropriés et non-inflammables.

4. Des gouttes de laitier en fusion sont émises de l'arc de soudage. Se protéger avec des vêtements de protection libres de l'huile, tels que les gants en cuir, chemise épaisse, pantalons sans revers, et chaussures montantes.

5. Toujours porter des lunettes de sécurité dans la zone de soudage. Utiliser des lunettes avec écrans lateraux dans les zones où l'on pique le laitier.

6. Eloigner les matériaux inflammables ou les recouvrir afin de prévenir tout risque d'incendie dû aux étincelles.

7. Quand on ne soude pas, poser la pince à une endroit isolé de la masse. Un court-circuit accidental peut provoquer un échauffement et un risque d'incendie.

8. S'assurer que la masse est connectée le plus prés possible de la zone de travail qu'il est pratique de le faire. Si on place la masse sur la charpente de la construction ou d'autres endroits éloignés de la zone de travail, on augmente le risque de voir passer le courant de soudage par les chaines de levage, câbles de grue, ou autres circuits. Cela peut provoquer des risques d'incendie ou d'echauffement des chaines et des câbles jusqu'à ce qu'ils se rompent.

9. Assurer une ventilation suffisante dans la zone de soudage. Ceci est particuliérement important pour le soudage de tôles galvanisées plombées, ou cadmiées ou tout autre métal qui produit des fumeés toxiques.

10. Ne pas souder en présence de vapeurs de chlore provenant d'opérations de dégraissage, nettoyage ou pistolage. La chaleur ou les rayons de l'arc peuvent réagir avec les vapeurs du solvant pour produire du phosgéne (gas fortement toxique) ou autres produits irritants.

11. Pour obtenir de plus amples renseignements sur la sûreté, voir le code "Code for safety in welding and cutting" CSA Standard W 117.2-1974.

PRÉCAUTIONS DE SÛRETÉ POUR LES MACHINES À SOUDER À TRANSFORMATEUR ET À REDRESSEUR

1. Relier à la terre le chassis du poste conformement au code de l'électricité et aux recommendations du fabricant. Le dispositif de montage ou la piece à souder doit être branché à une bonne mise à la terre.

2. Autant que possible, l'installation et l'entretien du poste seront effectués par un électricien qualifié.

3. Avant de faires des travaux à l'interieur de poste, la debrancher à l'interrupteur à la boite de fusibles.

4. Garder tous les couvercles et dispositifs de sûreté à leur place.

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TECHNICAL SPECIFICATIONS - POWER WAVE 655/R (K1519-1, K1519-2)

INPUT AT RATED OUTPUT - THREE PHASE ONLY

CODE NUMBERS	INPUT VOLTS	OUTPUT CONDITIONS	INPUT CURRENT AMPS	IDLE POWER	POWER FACTOR @ RATED OUPUT	EFFICIENCY @ RATED OUPUT
10630 10863	460/575V - 60HZ.	600A@44V.100% 815A@44V. 60%	43/34 53/42	400 Watts Max.	.95 MIN.	84%
11410	400V - 50HZ.	550A@44V.100% 675A@44V. 60%	40 51			
	460/575V - 60HZ.	600A@44V.100% 815A@44V. 60%	41/33 53/42			

OUTPUT

OPEN CIRCUIT VOLTAGE	CURRENT RANGE	PULSE FREQUENCY	PULSE VOLTAGE RANGE	PULSE AND BACKGROUND TIME RANGE	AUXILIARY POWER (CIRCUIT BREAKER PROTECTED)
75 VDC	20-880	0.15 - 1000 Hz	5 - 55 VDC	100 MICRO SEC. - 3.3 SEC.	40 VDC AT 10 AMPS 110 VAC AT 10 AMPS

PROCESS CURRENT RANGES (DC)	CURRENT
MIG/MAG	50-815 Average Amps
FCAW	40-815 Average Amps
SMAW	30-600 Average Amps
Pulse	15-880 Peak Amps

RECOMMENDED INPUT WIRE AND FUSE SIZES

INPUT VOLTAGE / FREQUENCY	TYPE 75°C COPPER WIRE IN CONDUIT AWG[MM²] SIZES	TYPE 75°C GROUND WIRE IN CONDUIT AWG[MM²] SIZES	TYPE 75°C (SUPER LAG) OR BREAKER SIZE (AMPS)
460V - 60HZ.	6 (16)	8 (10)	70
575V - 60HZ.	6(16)	10 (6)	60

PHYSICAL DIMENSIONS

HEIGHT	WIDTH	DEPTH	WEIGHT
26.10 in 663 mm	19.86 in 505 mm	32.88 in 835 mm	306 lbs. 139 kg.

TEMPERATURE RANGES

OPERATING TEMPERATURE RANGE	STORAGE TEMPERATURE RANGE
-20°C to +40°C	-40°C to +40°C

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SAFETY PRECAUTIONS

Read this entire installation section before you start installation.

⚠ WARNING

ELECTRIC SHOCK can kill.



- **Only qualified personnel should perform this installation.**
- **Turn the input power OFF at the disconnect switch or fuse box before working on this equipment. Turn off the input power to any other equipment connected to the welding system at the disconnect switch or fuse box before working on the equipment.**
- **Do not touch electrically hot parts.**
- **Always connect the Power Wave grounding lug (located inside the reconnect input access door) to a proper safety (Earth) ground.**

SELECT SUITABLE LOCATION

Do not use Power Waves in outdoor environments. The Power Wave power source should not be subjected to falling water, nor should any parts of it be submerged in water. Doing so may cause improper operation as well as pose a safety hazard. The best practice is to keep the machine in a dry, sheltered area.

Do not mount the PowerWave over combustible surfaces. Where there is a combustible surface directly under stationary or fixed electrical equipment, that surface shall be covered with a steel plate at least .060" (1.6mm) thick, which shall extend not less than 5.90" (150mm) beyond the equipment on all sides.

Place the welder where clean cooling air can freely circulate in through the rear louvers and out through the case sides and bottom. Dirt, dust, or any foreign material that can be drawn into the welder should be kept at a minimum. Do not use air filters on the air intake because the air flow will be restricted. Failure to observe these precautions can result in excessive operating temperatures and nuisance shutdowns.

Machines above code 10500 are equipped with F.A.N. (fan as needed) circuitry. The fan runs whenever the output is enabled, whether under loaded or open circuit conditions. The fan also runs for a period of time (approximately 5 minutes) after the output is disabled, to ensure all components are properly cooled.

If desired, the F.A.N. feature can be disabled (causing the fan to run whenever the power source is on). To disable F.A.N., connect leads 444 and X3A together at the output of the solid state fan control relay, located on the back of the Control PC board enclosure.

LIFTING

Lift the machine by the lift bail only. The lift bail is designed to lift the power source only. Do not attempt to lift the Power Wave with accessories attached to it.

STACKING

Power Wave machines can be stacked to a maximum of 3 high.

⚠ CAUTION

The bottom machine must always be placed on a firm, secure, level surface. There is a danger of machines toppling over if this precaution is not taken.

MACHINE GROUNDING

The frame of the welder must be grounded. A ground terminal marked with the symbol ⏚ is located inside the reconnect/input access door for this purpose. See your local and national electrical codes for proper grounding methods.

HIGH FREQUENCY PROTECTION

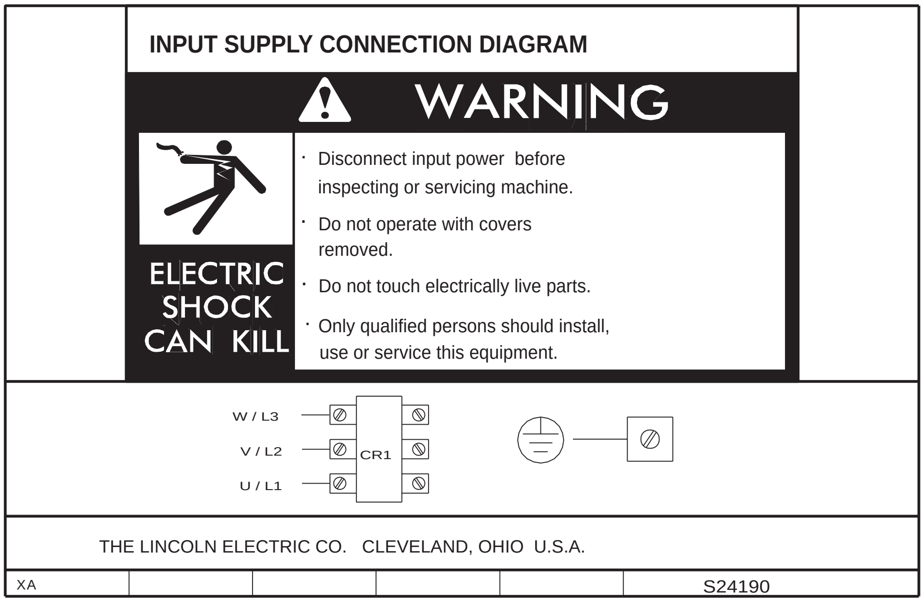
Locate the Power Wave away from radio controlled machinery.

⚠ CAUTION

The normal operation of the Power Wave may adversely affect the operation of RF controlled equipment, which may result in bodily injury or damage to the equipment.

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FIGURE A.1 - CONNECTION DIAGRAM ON CONNECTION/INPUT ACCESS DOOR



NOTE: Turn main input power to the machine OFF before performing connection procedure. Failure to do so will result in damage to the machine.

INPUT CONNECTION

⚠ WARNING

Only a qualified electrician should connect the input leads to the Power Wave. Connections should be made in accordance with all local and national electrical codes and the connection diagram located on the inside of the reconnect/input access door of the machine. Failure to do so may result in bodily injury or death.

Use a three-phase supply line. A 1.75 inch (45 mm) diameter access hole for the input supply is located on the upper left case back next to the input access door. Connect L1, L2, L3 and ground according to the Input Supply Connection Diagram decal located on the inside of the input access door or refer to Figure A.1 .

INPUT FUSE AND SUPPLY WIRE CONSIDERATIONS

Refer to the Technical Specifications at the beginning of this Installation section for recommended fuse and wire sizes. Fuse the input circuit with the recommended super lag fuse or delay type breakers (also called “inverse time” or “thermal/magnetic” circuit breakers). Choose an input and grounding wire size according to local or national electrical codes. Using fuses or circuit breakers smaller than recommended may result in “nuisance” shut-offs from welder inrush currents, even if the machine is not being used at high currents.

INPUT VOLTAGE CHANGE OVER (FOR MULTIPLE INPUT VOLTAGE MACHINES ONLY)

Welders are shipped connected for the highest input voltage listed on the rating plate. To move this connection to a different input voltage, see the diagram located on the inside of the input access door. If the main reconnect switch or link position is placed in the wrong position, the welder will not produce output power.

If the Auxiliary (**A**) lead is placed in the wrong position, there are two possible results. If the lead is placed in a position higher than the applied line voltage, the welder may not come on at all. If the Auxiliary (**A**) lead is placed in a position lower than the applied line voltage, the welder will not come on, and the two circuit breakers in the reconnect area will open. If this occurs, turn off the input voltage, properly connect the (**A**) lead, reset the breakers, and try again.

WELDING WITH MULTIPLE POWER WAVES

CAUTION

Special care must be taken when more than one Power Wave is welding simultaneously on a single part. Arc blow and arc interference may occur or be magnified.

Each power source requires a work lead from the work stud to the welding fixture. Do not combine all of the work leads into one lead. Perform welding in the direction away from the work leads. Connect all of the work sense leads from each power source to the work piece at the end of the joint.

For the best results when pulse welding, set the wire size and wire feed speed the same for all the Power Waves.

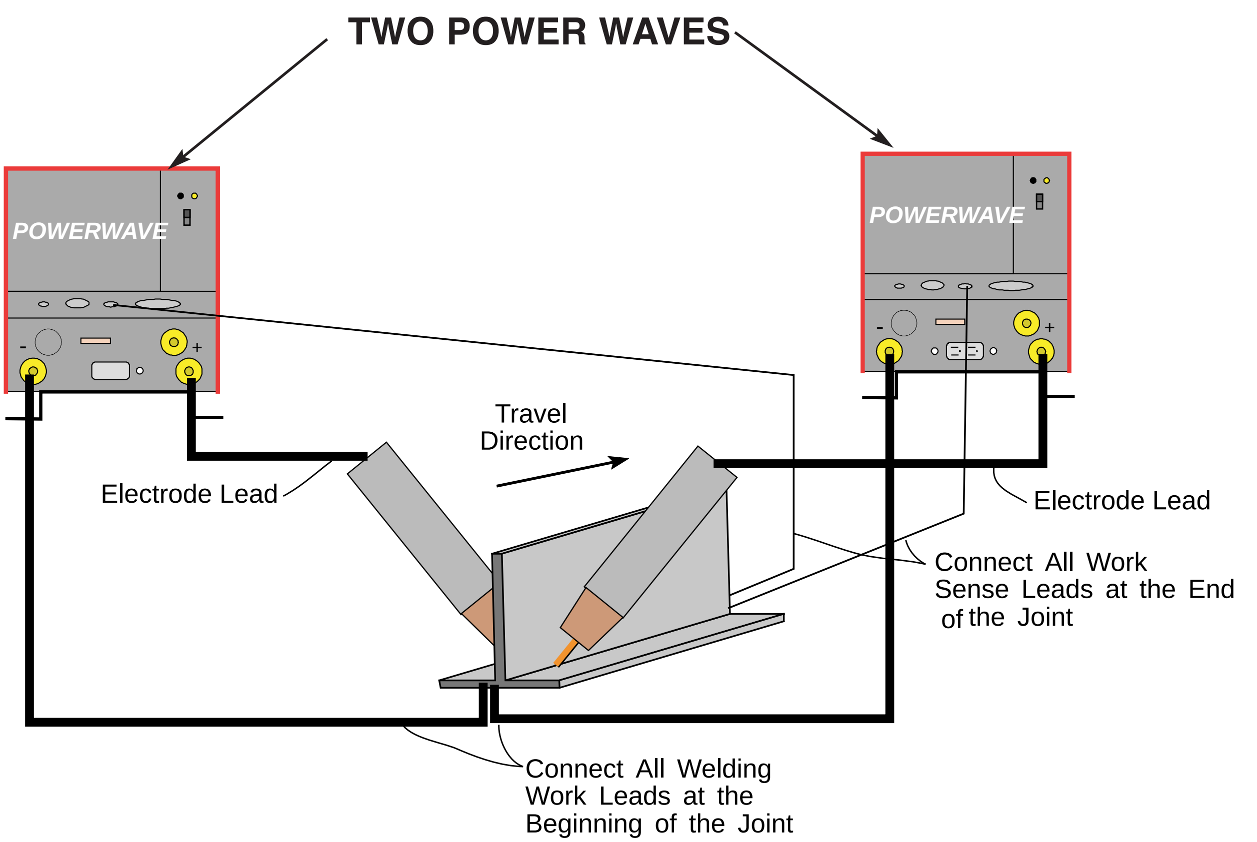
When these parameters are identical, the pulsing frequency will be the same, helping to stabilize the arcs.

Every welding gun requires a separate shielding gas regulator for proper flow rate and shielding gas coverage.

Do not attempt to supply shielding gas for two or more guns from only one regulator.

If an anti-spatter system is in use then each gun must have its own anti-spatter system. (See Figure A.2.)

FIGURE A.2



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ELECTRODE AND WORK CABLE CONNECTIONS

Connect a work lead of sufficient size and length (Per Table 1) between the proper output terminal on the power source and the work. Be sure the connection to the work makes tight metal-to-metal electrical contact. To avoid interference problems with other equipment and to achieve the best possible operation, route all cables directly to the work and wire feeder. Avoid excessive lengths and do not coil excess cable.

Minimum work and electrode cable sizes are as follows:

TABLE 1 (For cable length up to 100 ft, or 30 meters)

CURRENT (60% Duty Cycle)	MINIMUM COPPER
400 Amps	2/0 (67mm2)
500 Amps	3/0 (85mm2)
600 Amps	3/0 (85mm2)

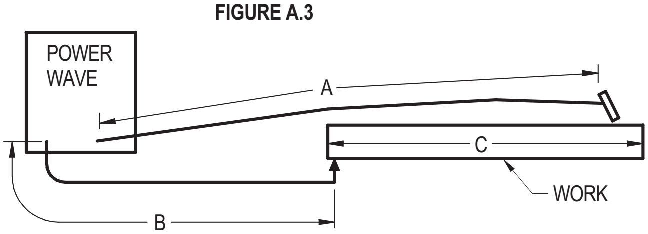
When using inverter type power sources like the Power Waves, use the largest welding (electrode and ground) cables that are practical. At least 2/0 copper wire - even if the average output current would not normally require it. When pulsing, the pulse current can reach very high levels. Voltage drops can become excessive, leading to poor welding characteristics, if undersized welding cables are used.

NOTE: K1796 coaxial welding cable is recommended to reduce the cable inductance in long cable lengths. This is especially important when Pulse welding up to 350 amps.

CABLE INDUCTANCE, AND ITS EFFECTS ON PULSE WELDING

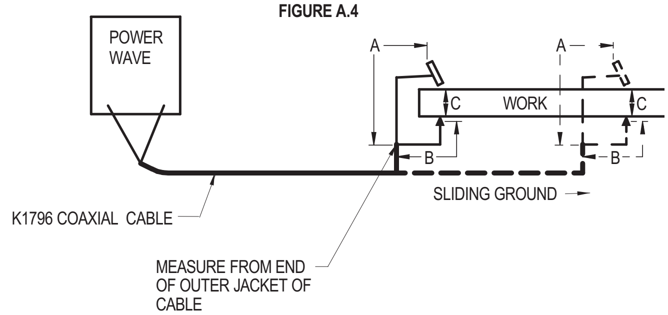
For Pulse Welding processes, cable inductance will cause the welding performance to degrade. For the total welding loop length less than 50ft.(15m), traditional welding cables may be used without any effects on welding performance. For the total welding loop length greater than 50ft.(15m), the K1796 Coaxial Welding Cables are recommended. The welding loop length is defined as the total of electrode cable length (A) + work cable length (B) + work length (C) (See Figure A.3).

FIGURE A.3



For long work piece lengths, a sliding ground should be considered to keep the total welding loop length less than 50ft.(15m). (See Figure A.4.)

FIGURE A.4



CAUTION

When pulsing, the pulse current can reach very high levels. Voltage drops can become excessive, leading to poor welding characteristics, if undersized welding cables are used.

Most welding applications run with the electrode being positive (+). For those applications, connect one end of the electrode cable to the positive (+) output stud on the power source (located beneath the spring loaded output cover near the bottom of the case front). Connect the other end of the electrode cable to the wire drive feed plate using the stud, lockwasher, and nut provided on the wire drive feed plate. The electrode cable lug must be against the feed plate. Be sure the connection to the feed plate makes tight metal-to-metal electrical contact. The electrode cable should be sized according to the specifications given in the work cable connections section. Connect a work lead from the negative (-) power source output stud to the work piece. The work piece connection must be firm and secure, especially if pulse welding is planned. Excessive voltage drops caused by poor work piece connections often result in unsatisfactory welding performance.

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NEGATIVE ELECTRODE POLARITY

When negative electrode polarity is required, such as in some Innershield applications, reverse the output connections at the power source (electrode cable to the negative (-) stud, and work cable to the positive (+) stud).

When operating with electrode polarity negative the DIP switch 7 must be set to ON on the Wire Feed Head PC Board. The default setting of the switch is OFF to represent positive electrode polarity.

Set the Negative Polarity switch on Wire Feed Head PC board as follows:

WARNING

ELECTRIC SHOCK can kill.



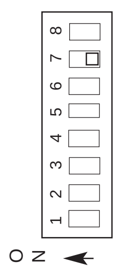
- **Do not touch electrically live parts or electrodes with your skin or wet clothing.**
- **Insulate yourself from the work and ground.**
- **Always wear dry insulating gloves.**

---

1. Turn off power to the power source at the disconnect switch.

2. Remove the front cover from the power source.

3. The Feed Head PC Board is on the right side of the power source. Locate the 8-position DIP switch and look for switch 7 of the DIP switch.



4. Using a pencil or other small object, slide the switch right to the OFF position for positive electrode polarity. Conversely, slide the switch left to the ON position for negative electrode polarity.

5. Replace the cover and screws. The PC board will "read" the switch at power up, and configure the work voltage sense lead appropriately.

VOLTAGE SENSING

The best arc performance occurs when the Power Waves has accurate data about the arc conditions. Depending upon the process, inductance within the electrode and work lead cables can influence the voltage apparent at the contact tip. Voltage sense leads improve the accuracy of the arc conditions and can have a dramatic effect on performance.

CAUTION

If the voltage sensing is enabled but the sense leads are missing or improperly connected, extremely high welding outputs may occur.

Do not tightly bundle the work sense lead to the work lead.

The ELECTRODE sense lead (67) is built into the K1795 control cable. The WORK sense lead (21) connects to the Power Wave at the four-pin connector located underneath the output stud cover.
Enable the voltage sense leads as follows:

TABLE 2

Process	Electrode Voltage Sensing 67 lead *	Work Voltage Sensing 21 lead
GMAW	67 lead required	21 lead optional**
GMAW-P	67 lead required	21 lead optional**
FCAW	67 lead required	21 lead optional**
GTAW	Voltage sense at studs	Voltage sense at studs
SAW	67 lead required	21 lead optional**

* The electrode voltage 67 sense lead is part of the control cable to the wire feeder.

** For consistent weld quality, work voltage sensing is recommended.

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Work Voltage Sensing

The Power Waves are shipped from the factory with the work sense lead enabled.

For processes requiring work voltage sensing, connect the (21) work voltage sense lead from the Power Wave to the work. Attach the sense lead to the work as close to the weld as practical. Enable the work voltage sensing in the Power Wave as follows:

⚠ WARNING

ELECTRIC SHOCK can kill.



- **Do not touch electrically live parts or electrodes with your skin or wet clothing.**
- **Insulate yourself from the work and ground.**
- **Always wear dry insulating gloves.**

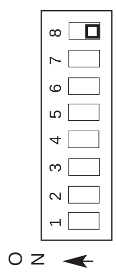
---

1. Turn off power to the power source at the disconnect switch.

2. Remove the front cover from the power source.

3. The control board is on the left side of the power source. Locate the 8-position DIP switch and look for switch 8 of the DIP switch.

4. Using a pencil or other small object, slide the switch right to the OFF position if the work sense lead is NOT connected. Conversely, slide the switch left to the ON position if the work sense lead is present.



5. Replace the cover and screws. The PC board will "read" the switch at power up, and configure the work voltage sense lead appropriately.

Electrode Voltage Sensing

Enabling or disabling electrode voltage sensing is automatically configured through software. The 67 electrode sense lead must be connected at the wire feeder.

POWER WAVE / POWER FEED WIRE FEEDER INTERCONNECTIONS

Connect the control cable between the power source and wire feeder. The wire feeder connection on the robotic Power Waves is located under the spring loaded output cover, near the bottom of the case front. The control cable is keyed and polarized to prevent improper connect.

For convenience, the electrode and control cables can be routed behind the left or right strain reliefs (under the spring loaded output cover), and along the channels formed into the base of the Power Wave, out the back of the channels, and then to the wire feeder.

Output connections on some Power Waves are made via **1/2-13** threaded output studs located beneath the spring loaded output cover at the bottom of the case front. On machines which carry the CE mark, output connections are made via Twist-Mate receptacles, which also located beneath the spring loaded output cover at the bottom of the case front.

A work lead must be run from the power source output stud to the work piece. The work piece connection must be firm and secure, especially if pulse welding is planned.

⚠ CAUTION

Excessive voltage drops at the work piece connection often result in unsatisfactory pulse welding performance.

CONTROL CABLE SPECIFICATIONS

It is recommended that genuine Lincoln control cables be used at all times. Lincoln cables are specifically designed for the communication and power needs of the Power Wave / Power Feed system.

⚠ CAUTION

The use of non-standard cables, especially in lengths greater than 25 ft(7.6m), can lead to communication problems (system shutdowns), poor motor acceleration (poor arc starting) and low wire driving force (wire feeding problems).

Lincoln control cables are copper 22 conductor cable in a SO-type rubber jacket.

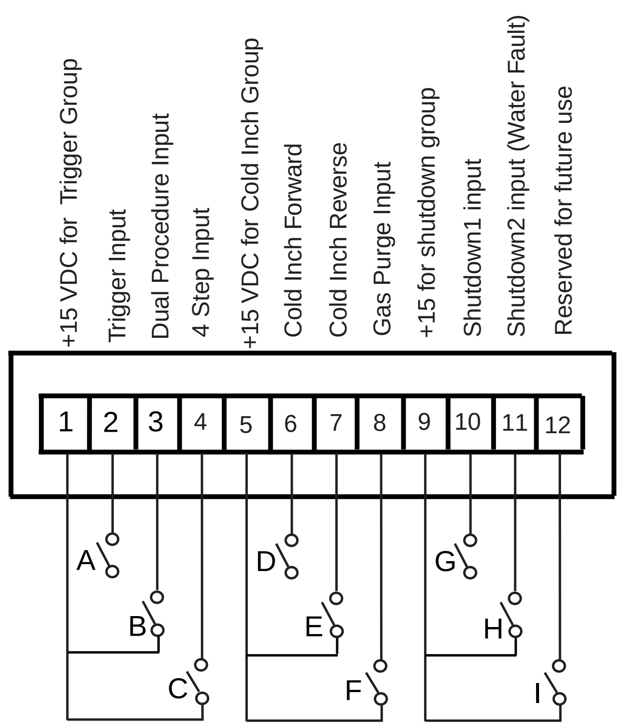
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EXTERNAL I/O CONNECTOR

The Power Wave is equipped with a port for making simple input signal connections. The port is divided into three groups: Trigger group, Cold Inch Group and Shutdown Group. Because the Power Wave is a 'slave' on the DeviceNet network, the Trigger and Cold Inch Groups are disabled when the DeviceNet / Gateway is active.

The shutdown group is always enabled. Shutdown 2 is used for signaling low flow in the water cooler. Unused shutdowns must be jumpered. Machines from the factory come with the shutdowns already jumpered.(See Figure A.5)

FIGURE A.5



HIGH SPEED GEAR BOX

Changing the ratio requires a gear change and a PC board switch change. The Power Feed Wire Feeders are shipped with both high speed and a low speed gears. As shipped from the factory, the low speed (high torque) gear is installed on the feeder. To change Gear ratio see Power Feed 10/R Instruction Manual.

⚠ WARNING

ELECTRIC SHOCK can kill.

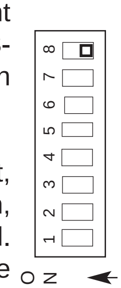


- **Do not touch electrically live parts or electrodes with your skin or wet clothing.**
- **Insulate yourself from the work and ground.**
- **Always wear dry insulating gloves.**

---

1. Set the High/Low switch code on Wire Drive PC board as follows:

   - Turn off power to the power source at the disconnect switch.
   - Remove the front cover from the power source.
   - The wire feed head board is on the right side of the power source. Locate the 8-position DIP switch and look for position 8 of the DIP switch.



   - Using a pencil or other small object, slide the switch right to the OFF position, when the low speed gear is installed. Conversely, slide the switch left to the ON position when the high speed gear is installed.
   - Replace the cover and screws. The PC board will "read" the switch at power up, automatically adjusting all control parameters for the speed range selected.

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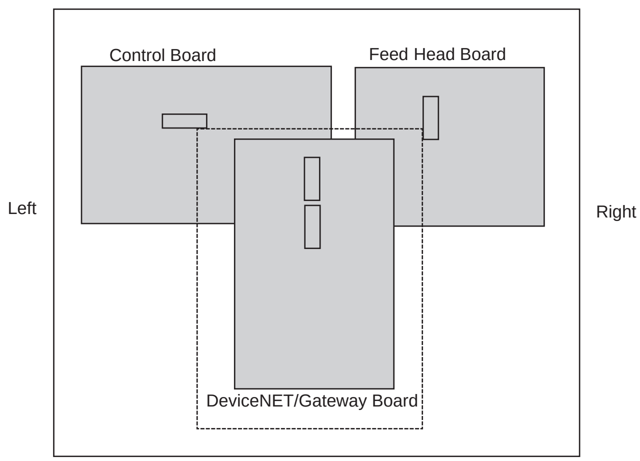
DIP Switch Settings and Locations

DIP switches on the P.C. Boards allow for custom configuration of the Power Wave. To access the DIP switches:

⚠ WARNING

• **Turn off power at the disconnect switch.**

- Remove the top four screws securing the front access panel.
- Loosen, but do not completely remove, the bottom two screws holding the access panel.
- Open the access panel, allowing the weight of the panel to be carried by the bottom two screws. Make sure to prevent the weight of the access panel from hanging on the harness.
- Adjust the DIP switches as necessary.
- Replace the panel and screws, and restore power.



Control Board DIP Switch:

switch 1 = Object Instance LSB[1] (see table 3)
switch 2 = Object Instance MSB[2] (see table 3)
switch 3 = Equipment Group 1 Select
switch 4 = Equipment Group 2 Select
switch 5 = Equipment Group 3 Select
switch 6 = Equipment Group 4 Select
switch 7 = reserved for future use
switch 8 = work sense lead

1 LEASE SIGNIFICANT BIT
2 MOST SIGNIFICANT BIT

switch 8	work sense lead
off	work sense lead not connected
on	work sense lead connected

Feed Head Board DIP Switch:

switch 1 = Object Instance LSB (see table 3)
switch 2 = Object Instance MSB (see table 3)
switch 3 = Equipment Group 1 Select
switch 4 = Equipment Group 2 Select
switch 5 = Equipment Group 3 Select
switch 6 = Equipment Group 4 Select
switch 7 = negative polarity switch

switch 7	electrode polarity
off	positive (default)
on	negative

switch 8 = high speed gear

switch 8	wire drive gear
off	low speed gear (default)
on	high speed gear

DeviceNET/Gateway Board DIP Switch:

Bank (S1):

switch 1 = Object Instance LSB (see table3)
switch 2 = Object Instance MSB (see table 3)
switch 3 = Equipment Group 1 Select
switch 4 = Equipment Group 2 Select
switch 5 = Equipment Group 3 Select
switch 6 = Equipment Group 4 Select
switch 7 = Reserved for future use
switch 8 = Reserved for future use

TABLE 3

Object Instance

switch 2	switch 1	Instance
off	off	0 (default)
off	on	1
on	off	2
on	on	3

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Bank (S2):

switch	Description
1 2	Devicenet Baud Rate (**see table 4**)

TABLE 4

Prior to S24958-6 software		
switch 1	switch 2	baud rate
off	off	Programmable value
on	off	125K
off	on	250K
on	on	500K
S24958-6 and later software		
switch 1	switch 2	baud rate
off	off	125K
off	on	250K
on	off	500K
on	on	Programmable value

Bank (S2):

switch	Description
3 thru 8	Devicenet Mac ID (**see table 5**)

TABLE 5

	SWITCH 8	SWITCH 7	SWITCH 6	SWITCH 5	SWITCH 4	SWITCH 3	
0	0	0	0	0	0	0	*
1	0	0	0	0	0	1	
2	0	0	0	0	1	0	
3	0	0	0	0	1	1	
4	0	0	0	1	0	0	
5	0	0	0	1	0	1	
6	0	0	0	1	1	0	
7	0	0	0	1	1	1	
8	0	0	1	0	0	0	
9	0	0	1	0	0	1	
10	0	0	1	0	1	0	
11	0	0	1	0	1	1	
12	0	0	1	1	0	0	
13	0	0	1	1	0	1	
14	0	0	1	1	1	0	
15	0	0	1	1	1	1	
16	0	1	0	0	0	0	
17	0	1	0	0	0	1	
18	0	1	0	0	1	0	
19	0	1	0	0	1	1	
20	0	1	0	1	0	0	
21	0	1	0	1	0	1	
22	0	1	0	1	1	0	
23	0	1	0	1	1	1	
24	0	1	1	0	0	0	
25	0	1	1	0	0	1	
26	0	1	1	0	1	0	
27	0	1	1	0	1	1	
28	0	1	1	1	0	0	
29	0	1	1	1	0	1	
30	0	1	1	1	1	0	
31	0	1	1	1	1	1	
32	1	0	0	0	0	0	
33	1	0	0	0	0	1	
34	1	0	0	0	1	0	
35	1	0	0	0	1	1	
36	1	0	0	1	0	0	
37	1	0	0	1	0	1	
38	1	0	0	1	1	0	
39	1	0	0	1	1	1	
40	1	0	1	0	0	0	
41	1	0	1	0	0	1	
42	1	0	1	0	1	0	
43	1	0	1	0	1	1	
44	1	0	1	1	0	0	
45	1	0	1	1	0	1	
46	1	0	1	1	1	0	
47	1	0	1	1	1	1	
48	1	1	0	0	0	0	
49	1	1	0	0	0	1	
50	1	1	0	0	1	0	
51	1	1	0	0	1	1	
52	1	1	0	1	0	0	
53	1	1	0	1	0	1	
54	1	1	0	1	1	0	
55	1	1	0	1	1	1	
56	1	1	1	0	0	0	
57	1	1	1	0	0	1	
58	1	1	1	0	1	0	
59	1	1	1	0	1	1	
60	1	1	1	1	0	0	
61	1	1	1	1	0	1	
62	1	1	1	1	1	0	**

*Software Selectable (Line 0)
**Default Setting (Line 62)

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SAFETY PRECAUTIONS

Read this entire section of operating instructions before operating the machine.

⚠ WARNING



ELECTRIC SHOCK can kill.

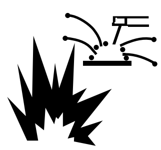
- Unless using cold feed feature, when feeding with gun trigger, the electrode and drive mechanism are always electrically energized and could remain energized several seconds after the welding ceases.

- Do not touch electrically live parts or electrodes with your skin or wet clothing.
- Insulate yourself from the work and ground.
- Always wear dry insulating gloves.



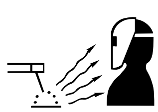
FUMES AND GASES can be dangerous.

- Keep your head out of fumes.
- Use ventilation or exhaust to remove fumes from breathing zone.



WELDING SPARKS can cause fire or explosion.

- Keep flammable material away.
- Do not weld on containers that have held combustibles.



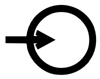
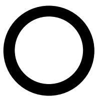
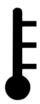
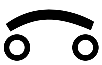
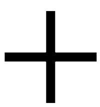
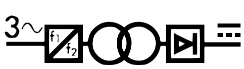
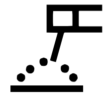
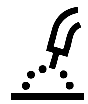
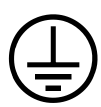
ARC RAYS can burn.

- Wear eye, ear, and body protection.

Observe additional guidelines detailed in the beginning of this manual.

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GRAPHIC SYMBOLS THAT APPEAR ON THIS MACHINE OR IN THIS MANUAL

Symbol	Meaning
	INPUT POWER
	ON
	OFF
	HIGH TEMPERATURE
	MACHINE STATUS
	CIRCUIT BREAKER
	WIRE FEEDER
	POSITIVE OUTPUT
	NEGATIVE OUTPUT
	3 PHASE INVERTER
	INPUT POWER
3 ~	THREE PHASE
	DIRECT CURRENT
	SMAW
	GMAW
	FCAW
	GTAW
U_0	OPEN CIRCUIT VOLTAGE
U_1	INPUT VOLTAGE
U_2	OUTPUT VOLTAGE
I_1	INPUT CURRENT
I_2	OUTPUT CURRENT
	PROTECTIVE GROUND
	WARNING OR CAUTION

GENERAL DESCRIPTION

The Power Wave power source is designed to be a part of a modular, multi-process welding system. Depending on configuration, it can support constant current, constant voltage, and pulse welding modes.

The Power Wave power source is designed to be used with the family of Power Feed wire feeders, operating as a system. Each component in the system has special circuitry to "talk with" the other system components, so each component (power source, wire feeder, electrical accessories) knows what the other is doing at all times. The components communicate with Arc-Link.

Robotic systems can communicate with other industrial machines via DeviceNET. The result is highly intrigated and flexible welding cell.

The Power Wave 655/R is a high performance, digitally controlled inverter welding power source capable of complex, high-speed waveform control. Properly equipped, it can support the GMAW, GMAW-P, FCAW, SMAW, GTAW and CAC-A processes. It carries an output rating of either 650 amps, 44 volts (at 100% duty cycle) and 800 amps, 44 volts (at 60% duty cycle).

If the duty cycle is exceeded, a thermostat will shut off the output until the machine cools to a reasonable operating temperature.

RECOMMENDED PROCESSES AND EQUIPMENT

RECOMMENDED PROCESSES

The Power Wave 655/R can be set up in a number of configurations, some requiring optional equipment or welding programs. Each machine is factory preprogrammed with multiple welding procedures, typically including GMAW, GMAW-P, FCAW, GTAW,CAC-A, and SMAW for a variety of materials, including mild steel, stainless steel, cored wires, and aluminum.

The Power Wave 655/R can be configured for either robotic or semi-automatic use.

RECOMMENDED EQUIPMENT

- **Automatic Operation**

  All welding programs and procedures are set through software for the robotic Power Waves. FANUC robots equipped with RJ-3 controllers may communicate directly to the Power Wave. Other pieces of equipment such as PLC's or computers can communicate to the Power Wave using DeviceNET.
  All wire welding processes require a robotic Power Feed wire feeder.

- **Semi-Automatic Operation**

  Operating the Power Wave 655/R in the semi-automatic mode requires an Arc-Link compatible wire feeder and user interface.

REQUIRED EQUIPMENT

- Control Cables (22 pin to 22 pin), K1795-10ft.,-25ft.,-50ft., -100ft.
- Control Cables for use on FANUC robot arm, 22 pin to 14 pin, 10ft.(3m), K1804-1
- Control Cables for use on FANUC robot arm, 22 pin to 14 pin, 18in.(457mm), K1805-1
- Control Cables for use on FANUC robot arm, 22 pin to 14 pin, 18in.(457mm), K1804-2

LIMITATIONS

- Power Waves are not to be used in outdoor environments.
- Only Arc-Link Power Feed wire feeders and user interfaces may be used. Other Lincoln wire feeders or non-Lincoln wire feeders cannot be used.

DUTY CYCLE AND TIME PERIOD

The Power Feed wire feeders are capable of welding at a 100% duty cycle (continuous welding). The power source will be the limiting factor in determining system duty cycle capability. Note that the duty cycle is based upon a ten minute period. A 60% duty cycle represents 6 minutes of welding and 4 minutes of idling in a ten minute period.

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CASE FRONT CONTROLS

All operator controls and adjustments are located on the case front of the Power Wave. (See Figure B.1)

1. POWER SWITCH: Controls input power to the Power Wave.
2. STATUS LIGHT: A two color light that indicates system errors. Normal operation is a steady green light. Error conditions are indicated per table 4.

NOTE: The robotic Power Wave's status light will flash green, and sometimes red and green, for up to one minute when the machine is first turned on. This is a normal situation as the machine goes through a self test at power up.

TABLE 6

Light Condition	Meaning
Steady Green	System OK. Power source communicating normally with wire feeder and its components.
Blinking Green	Occurs during a reset, and indicates the PW-655/R is mapping (identifying) each component in the system. Normal for first 1-10 seconds after power is turned on, or if the system configuration is changed during operation.
Alternating Green and Red	Non-recoverable system fault. If the PS Status light is flashing any combination of red and green, errors are present in the PW-655/R. Read the error code before the machine is turned off. Error Code interpretation through the Status light is detailed in the Service Manual. Individual code digits are flashed in red with a long pause between digits. If more than one code is present, the codes will be separated by a green light. To clear the error, turn power source off, and back on to reset. See Troubleshooting Section.
Steady Red	Not applicable.
Blinking Red	Not applicable.

3. HIGH TEMPERATURE LIGHT (thermal overload): A yellow light that comes on when an over temperature situation occurs. Output is disabled until the machine cools down. When cool, the light goes out and output is enabled.

4. 10 AMP WIRE FEEDER CIRCUIT BREAKER: Protects 40 volt DC wire feeder power supply.

5. 10 AMP AUXILIARY POWER CIRCUIT BREAKER: Protects 110 volt AC case front receptacle auxiliary supply.

6. LEAD CONNECTOR S2 (SENSE LEAD)

7. 5-PIN ARC LINK S1

8. 5-PIN DEVICENET CONNECTOR S5

9. I / O CONNECTOR

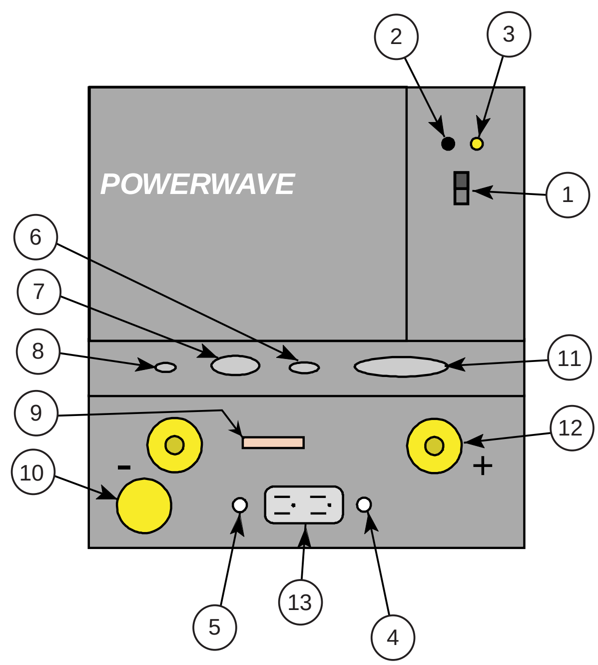
10. NEGATIVE STUD

11. INTERFACE CONNECTOR S6

12. POSITIVE STUD

13. AUXILIARY OUTPUT

FIGURE B.1



Case Front Layout
Power Wave 655/R (Domestic/Canadian Version)

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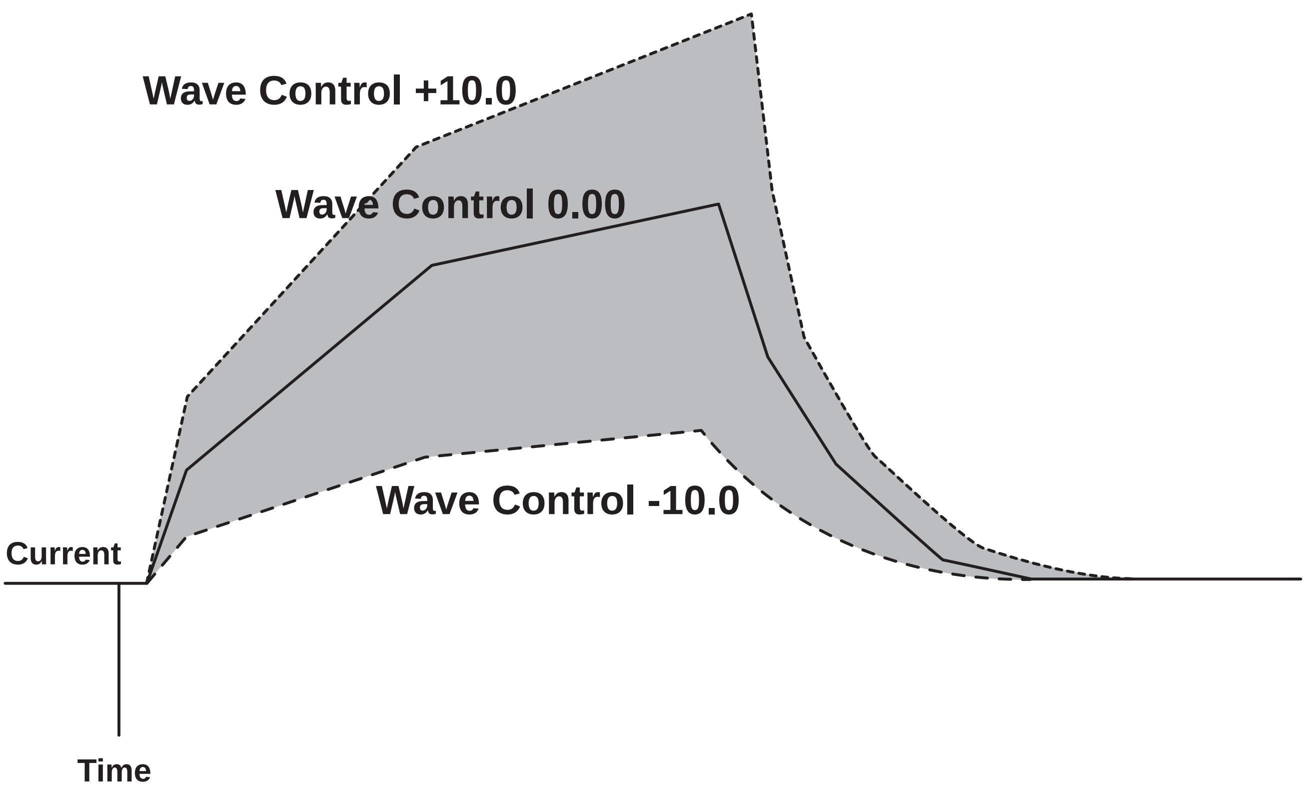
WELDING MODE DESCRIPTIONS

CONSTANT VOLTAGE WELDING

For each wire feed speed, a corresponding voltage is preprogrammed into the machine through special software at the factory. The preprogrammed voltage is the best average voltage for a given wire feed speed. With synergic programs, when the wire feed speed changes, the Power Wave will automatically adjust the corresponding voltage.

Wave control adjusts the inductance of the waveshape. (This adjustment is often referred to as "pinch". Inductance is inversely proportional to pinch.) Increasing wave control greater than 0 results in a harsher, colder arc, while decreasing the wave control to less than 0 provides a softer, hotter arc. (See Figure B.2.)

FIGURE B.2 – CV WAVE CONTROL CHARACTERISTICS



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PULSE WELDING

Pulse welding procedures are set by controlling an overall "arc length" variable. When pulse welding, the arc voltage is highly dependent upon the waveform. The peak current, back ground current, rise time, fall time and pulse frequency all affect the voltage. The exact voltage for a given wire feed speed can only be predicted when all the pulsing waveform parameters are known. Using a preset voltage becomes impractical, and instead the arc length is set by adjusting "trim".

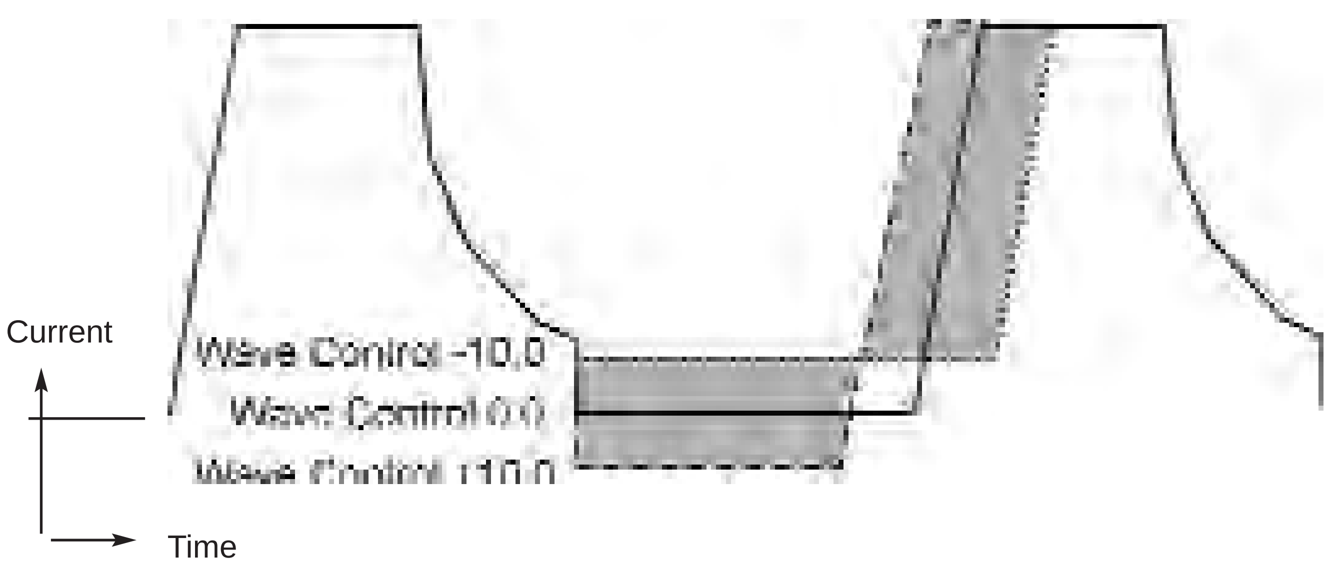
Trim adjusts the arc length and ranges from 0.50 to 1.50, with a nominal value of 1.00. Trim values greater than 1.00 increase the arc length, while values less than 1.00 decrease the arc length.

Most pulse welding programs are syngeric. As the wire feed speed is adjusted, the Power Wave will automatically recalculate the waveform parameters to maintain similar arc properties.

The Power Wave utilizes "adaptive control" to compensate for changes in electrical stick-out while welding. (Electrical stick-out is the distance from the contact tip to the work piece.) The Power Wave waveforms are optimized for a 0.75" (19mm) stick-out. The adaptive behavior supports a range of stickouts from 0.50" (13mm) to 1.25" (32mm). At very low or high wire feed speeds, the adaptive range may be less due to reaching physical limitations of the welding process.

Wave control in pulse programs usually adjusts the focus or shape of the arc. Wave control values greater than 0 increase the pulse frequency while decreasing the background current, resulting in a tight, stiff arc best for high speed sheet metal welding. Wave control values less than 0 decrease the pulse frequency while increasing the background current, for a soft arc good for out-of-position welding. (See Figure B.3)

FIGURE B.3 - PULSE WAVE CONTROL CHARACTERISTICS



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OPTIONAL EQUIPMENT

FACTORY INSTALLED

There are no factory installed options available for the Power Wave.

FIELD INSTALLED

Gas Guard Regulator (K659-1)

The Gas Guard regulator is available as an optional accessory for Power Feed Robotic wire drive unit. Install the 5/8-18 male outlet on the regulator to the proper 5/8-18 female gas inlet on the back panel of the wire drive. Secure fitting with flow adjuster key at top.

Voltage Sense Leads (K490-10, -25 or -50)

The voltage sense leads connect at the front of the machine.

Cool Arc 40 (K1813-1)

*** Water Flow Sensor (K1536-1)**

Water cooled guns can be damaged very quickly if they are used even momentarily without water flowing. Recommend practice is to install a water flow sensor such as on the water return line of the torch. When fully integrated into the welding system, the sensor will prevent welding if no water flow is present.

- **Dual Cylinder Undercarriage, K1570-1***

*The Dual Cylinder Undercarriage, K1570-1 is not compatible in combination with the Power Wave Water Cooler K1767-1.

- **Coaxial welding Cable, K1796**

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SAFETY PRECAUTIONS

⚠ WARNING

ELECTRIC SHOCK can kill.



- Only Qualified personnel should perform this maintenance.
- Turn the input power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

ROUTINE MAINTENANCE

PERFORM THE FOLLOWING DAILY:

1. Check that no combustible materials are in the welding or cutting area or around the machine.
2. Remove any debris, dust, dirt, or materials that could block the air flow to the machine for cooling.
3. Inspect the electrode cables for any slits or punctures in the cable jacket, or any condition that would affect the proper operation of the machine.

PERIODIC MAINTENANCE

PERFORM PERIODICALLY:

Clean the inside of the machine with a low pressure air stream. Clean the following parts. Refer to ***Figure D.1.***

- Transformer and output rectifier assembly.
- Electrode and work cable connections.
- PC board connections..
- Intake and outlet louvers on the machine case.
- Any obvious accumulations of dirt within the machine.
- Fan Assembly.

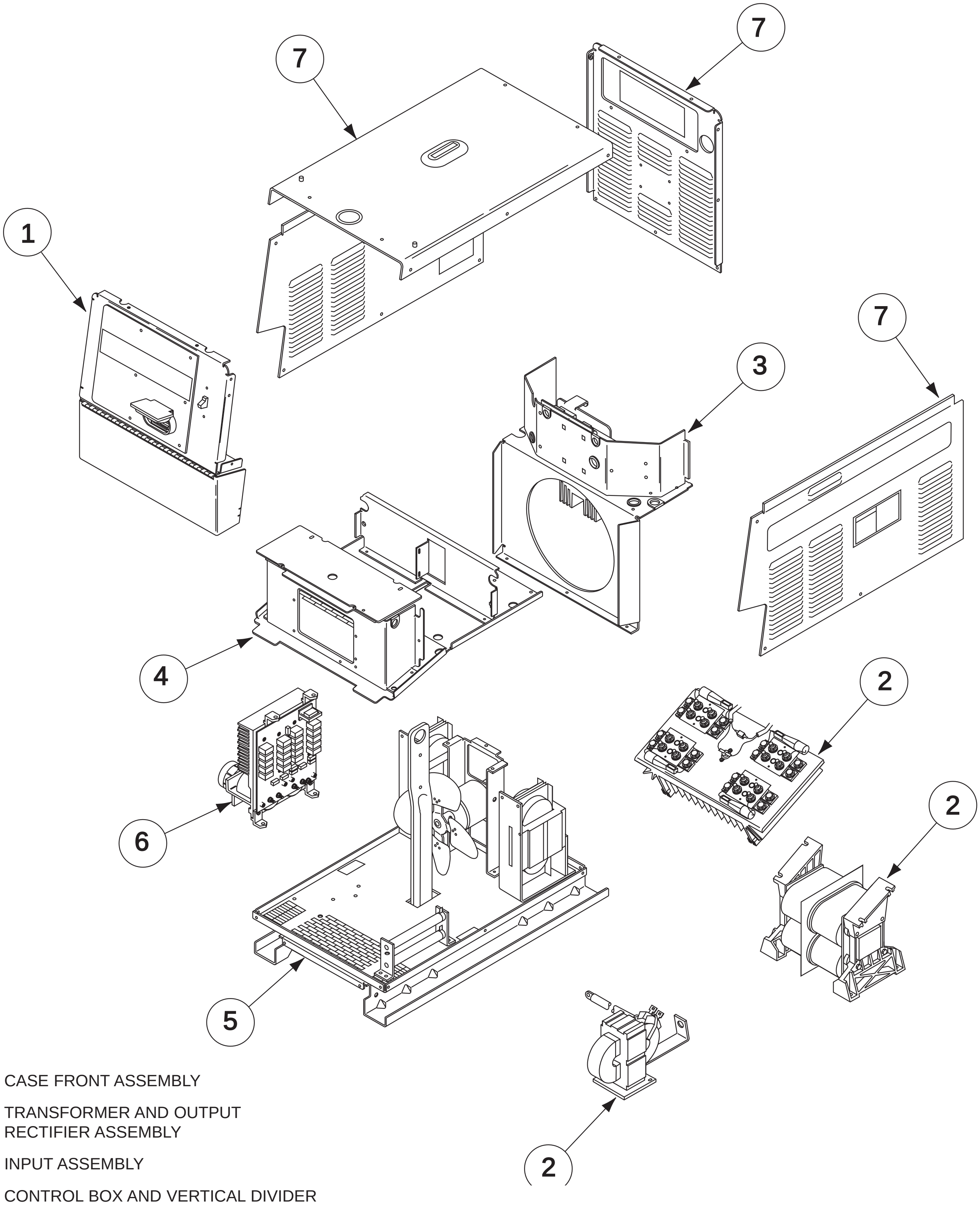
NOTE: The fan motor has sealed bearings which require no maintenance.

CALIBRATION SPECIFICATION

Calibration of the PW-655/R is critical to its operation. The output Voltage and Current are calibrated at the factory and generally speaking the calibration will not need adjustment. However, neglected or improperly calibrated machines may not yield satisfactory weld performance. To ensure optimal performance, the calibration of output Voltage and Current should be checked yearly.

The calibration procedure itself requires the use of a grid (Resistive Load Bank), and certified actual meters for voltage and current. The accuracy of the calibration will be directly affected by the accuracy of the measuring equipment you use. The **Diagnostics Utility** includes detailed instructions, and is available on the **Power Wave Submerged Arc Utilities** disc that comes with the machine, on the **Service Navigator** DVD's or on *Powerwavesoftware.com*. If the system does not calibrate properly see the troubleshooting section of this manual.

FIGURE D.1 – MAIN ASSEMBLY (EXPLODED VIEW)



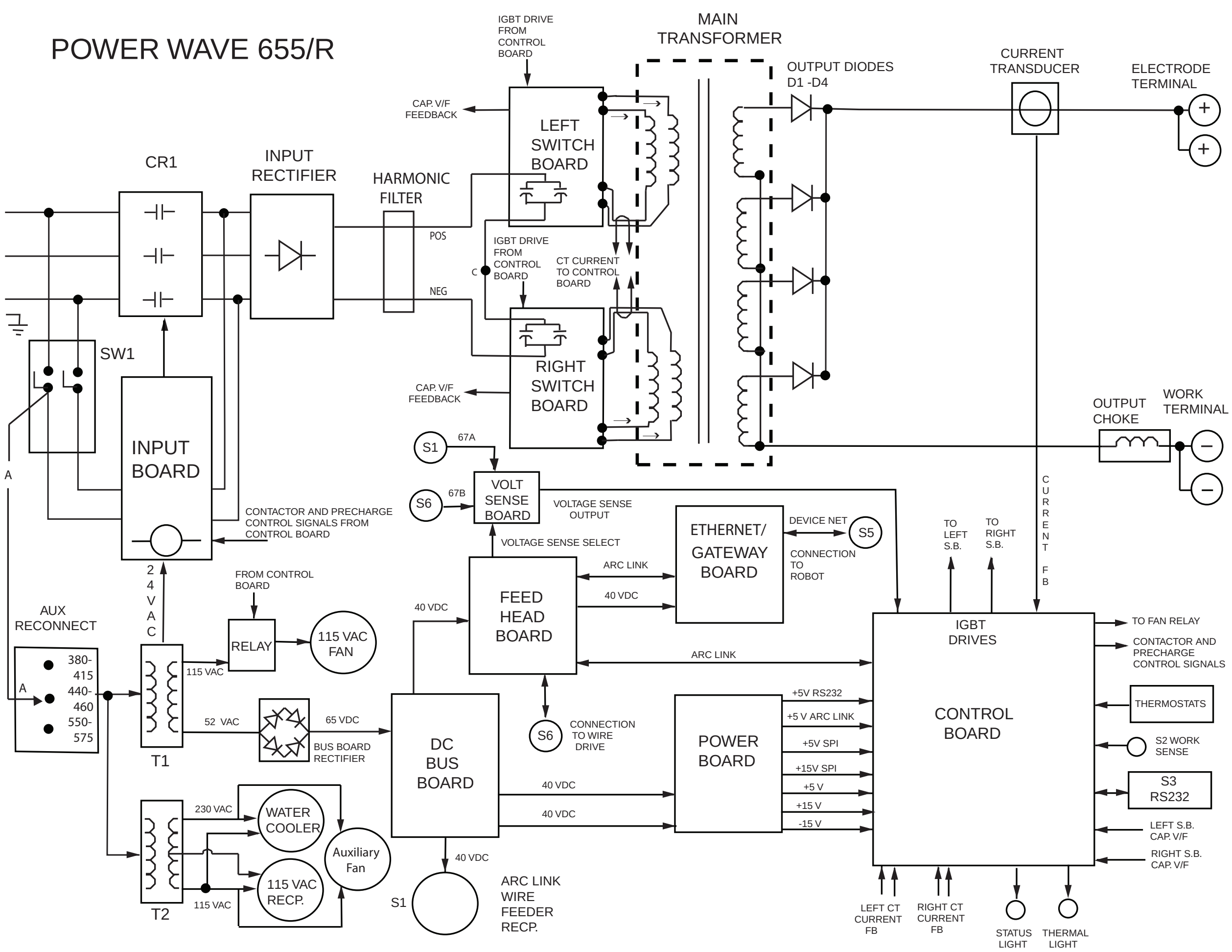
1. CASE FRONT ASSEMBLY
2. TRANSFORMER AND OUTPUT RECTIFIER ASSEMBLY
3. INPUT ASSEMBLY
4. CONTROL BOX AND VERTICAL DIVIDER ASSEMBLY
5. BASE, LIFT BAIL AND FAN ASSEMBLY
6. SWITCH BOARD HEATSINK ASSEMBLY
7. CASE PARTS

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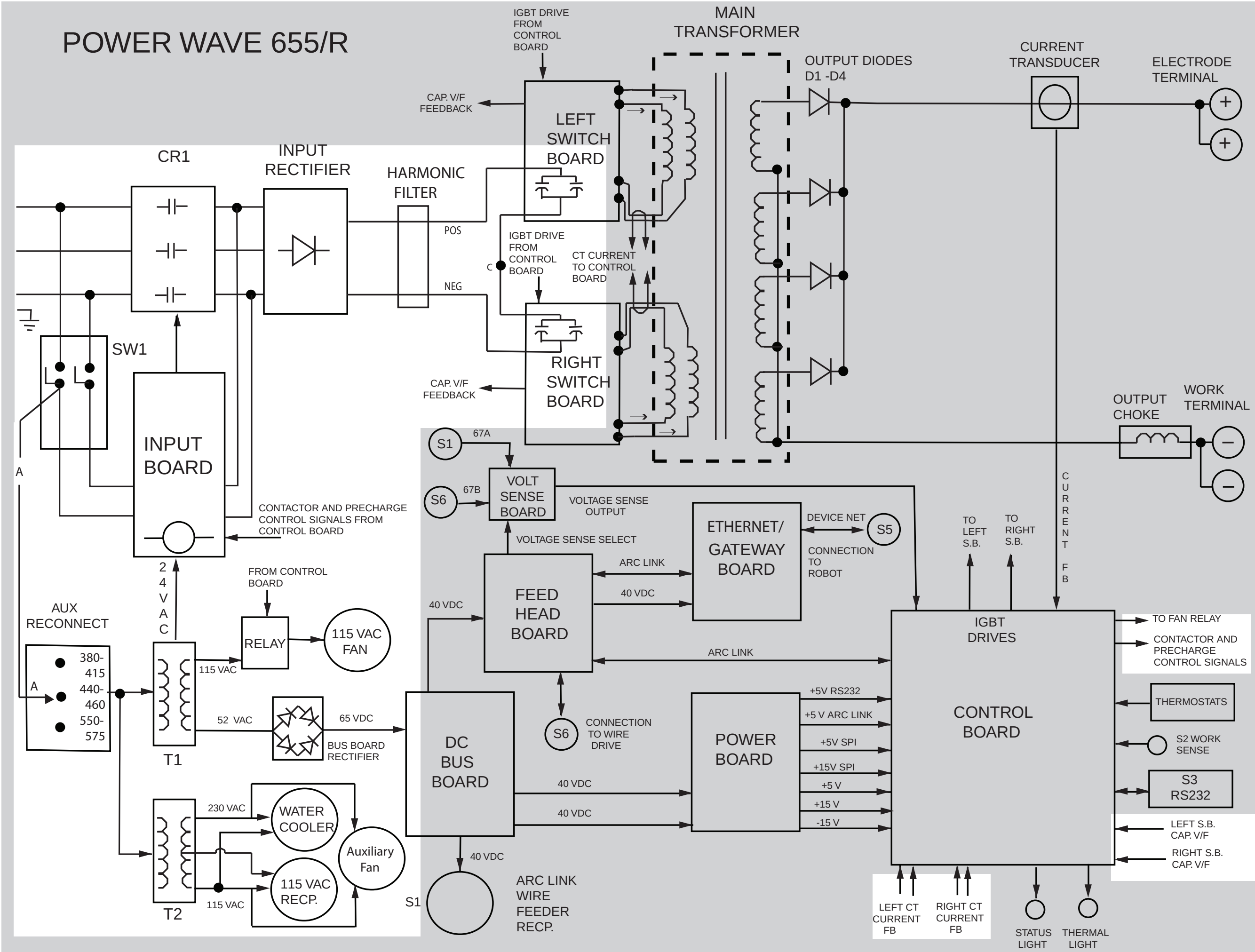
TABLE OF CONTENTS - THEORY OF OPERATION

FIGURE E.1 — BLOCK LOGIC DIAGRAM.



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FIGURE E.2 – INPUT VOLTAGE AND PRECHARGE



GENERAL DESCRIPTION

The Power Wave 655/R power source is designed to be a part of a modular, multi-process welding system. It is a high performance, digitally controlled inverter welding power source capable of complex, high-speed waveform control.

The Power Wave 655/R is designed to be used with the family of Power Feed wire feeders, operating as a system. Each component in the system has special circuitry to "talk with" the other system components, so each component (power source, wire feeder, electrical accessories) knows what the other is doing at all times. The components communicate with Arc-Link.

Robotic systems can communicate with other industrial machines via DeviceNET or Arc Link. The result is highly integrated and flexible welding cell.

Depending upon configuration, it can support constant current, constant voltage, and pulse welding modes. Each machine is factory preprogrammed with multiple welding procedures. Typically these procedures include GMAW, GMAW-P, FCAW, GTAW for a variety of materials such as mild steel, stainless steel, cored wires and aluminum.

The Power Wave 655/R has an output rating of either 650 amps at 44 (at 100% duty cycle) volts or 800 amps at 44 volts (at 60% duty cycle).

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion

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INPUT VOLTAGE AND PRECHARGE

The Power Wave 655/R can be connected for a variety of three-phase input voltages. Refer to ***Figure E.2.*** The initial input power is applied through a line switch located on the front of the machine. Two phases of the three-phase input power are applied simultaneously to the Input Board and both auxiliary transformers.

The various secondary voltages developed by transformer T1 are applied to the Input Board, the fan motor (via a control relay) and the Bus Board rectifier. The 65VDC produced from the Bus Board rectifier is used by the Bus Board to provide various DC voltages for the Power Board, the Feed Head Board, the Ethernet/Gateway Board and the wire feeder receptacle.

The 115/230VAC developed on the secondary of auxiliary transformer T2 is applied to the 115VAC receptacle and to the water cooler receptacle. The 230VAC supply is also used to operate an auxiliary cooling fan in the upper section of the machine. This fan runs whenever the power switch is ON.

The large fan in the lower section only runs when the machine is producing output. It is activated through a solid state relay that responds to a signal from the Control Board.

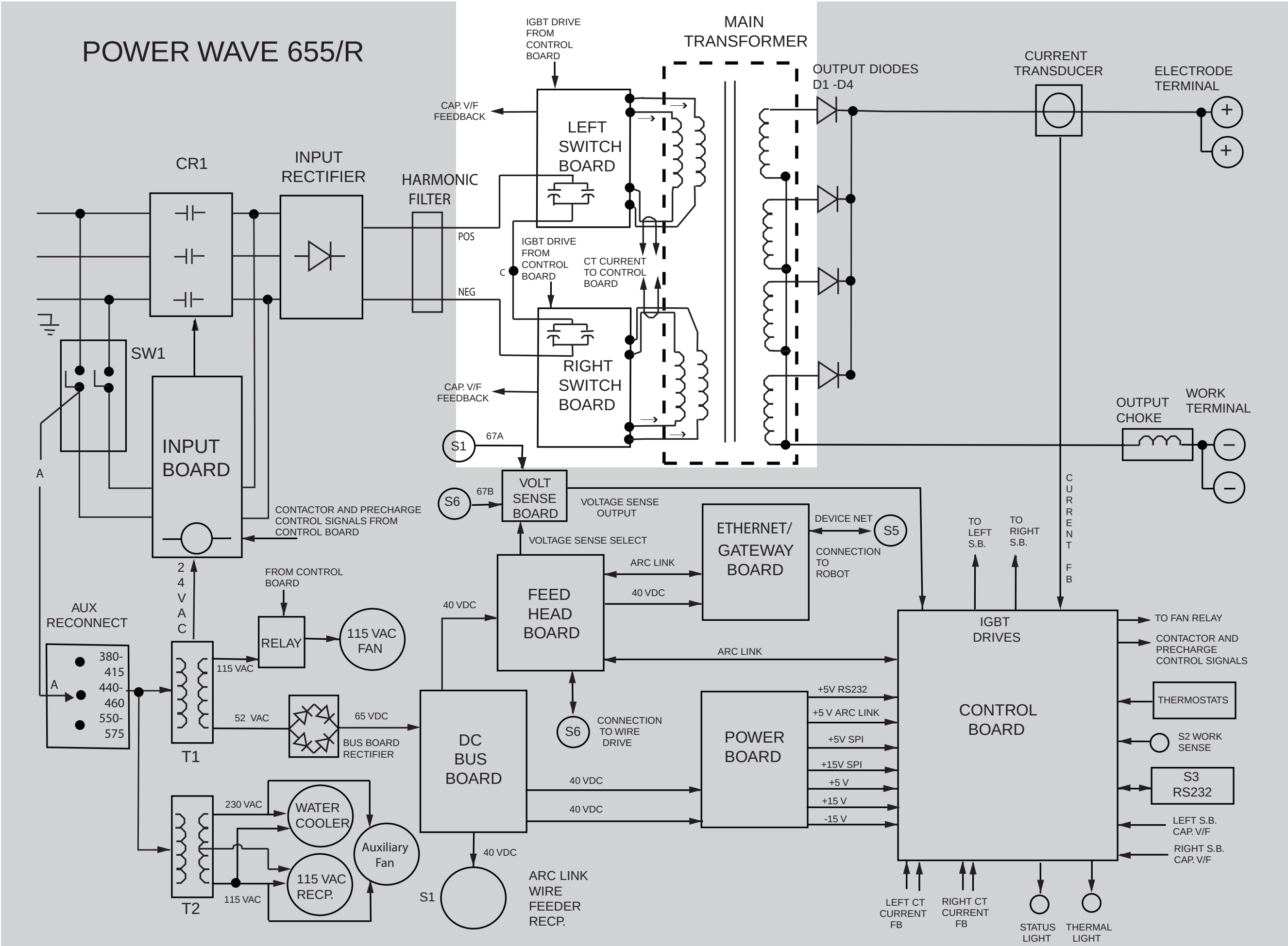
Two of the input lines are connected to the Input Board, by way of the input line switch SW1. They are then connected to the input rectifier through the precharge relay on the Input Board. During the precharge or "soft start" sequence, these two phases are current limited by resistord on the Input Board.

The AC input voltage is rectified, and the resultant DC voltage is applied through a harmonic filter to the input capacitors located on the right and left switch boards.

A Voltage to Frequency circuit on the Switch Boards sends a signal to the Control Board. When the capacitors have charged to an acceptable level, the Control Board signals the Input Board to energize the main input contactor (CR-1). At this point the Power Wave 655/R is in the "Run Mode" of operation. If the capacitors become undervoltaged, overvoltaged, or unbalanced, the Control Board will signal the Input Board to de-energize the main input contactor, and the Power Wave 655/R will be disabled. See ***Figure E.2.***

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FIGURE E.3 - SWITCH BOARDS AND MAIN TRANSFORMER



SWITCH BOARDS AND MAIN TRANSFORMER

There are two switch boards in the Power Wave 655/R machine. Each contains two input capacitors and insulated gate bipolar transistor (IGBT) switching circuitry. Refer to Figure E.3. The input capacitors on each board are connected in parallel. The two paralleled pairs are then connected in series to accomodate the high DC voltage from the rectifier.

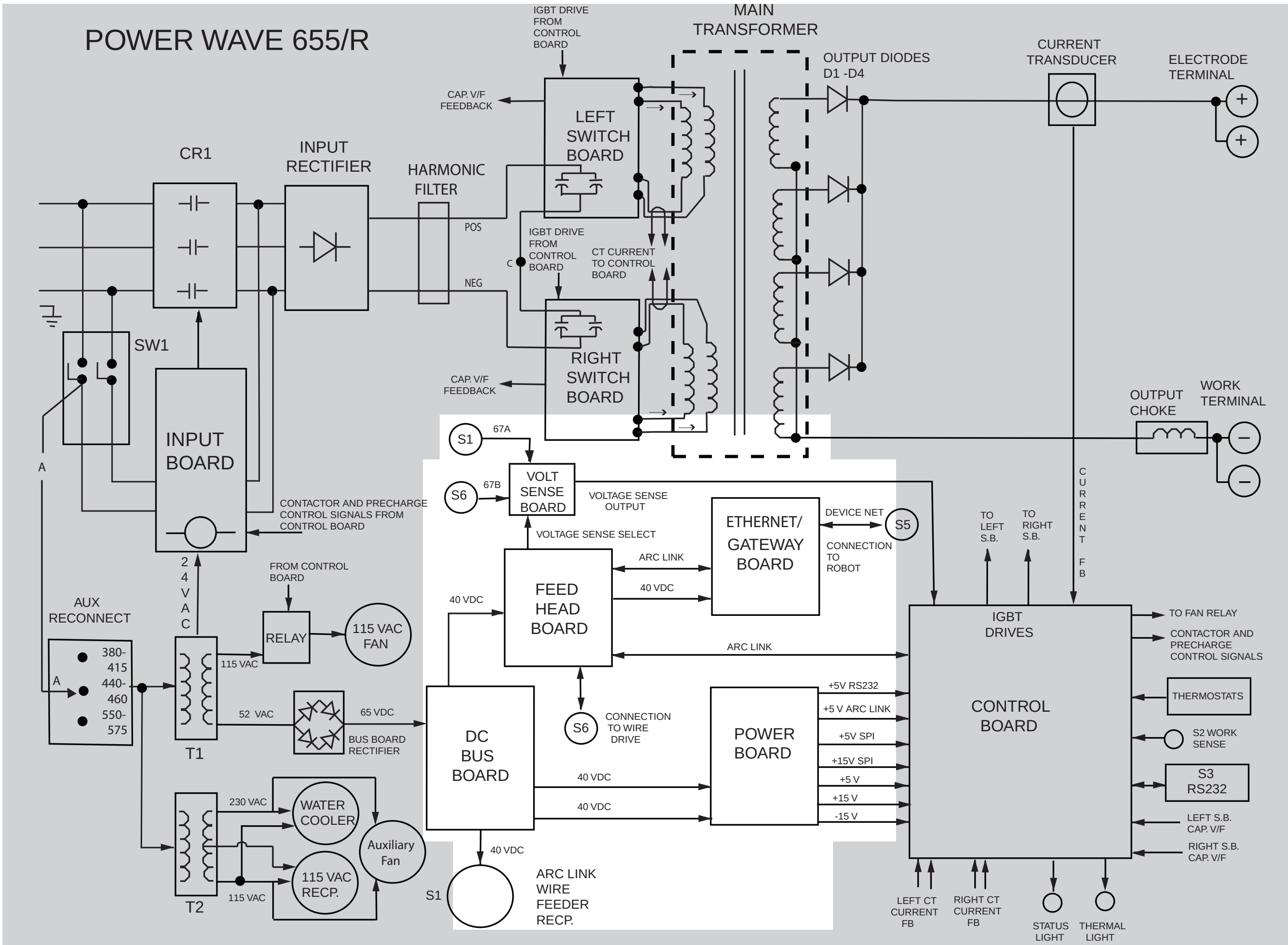
When the input capacitors are fully charged, they act as power supplies for the IGBT (insulated gate bipolar transistors) switching circuits. The IGBT's switch the DC power from the input capacitors "on and off," thus supplying pulsed DC current to the main transformer primary windings. See ***IGBT OPERATION DISCUSSION AND DIAGRAMS*** in this section.

Each switch board feeds current to separate, oppositely wound primary coils in the Main Transformer. The reverse directions of current flow through the main transformer primaries, and the offset timing of the IGBT switch boards induce an AC square wave output signal at the secondary of the main transformer. Current transformers monitor the primary currents. If the primary currents become abnormally high, the Control Board will shut off the IGBTs, thus disabling the machine's output. The DC current flow through each primary winding is clamped back to each respective input capacitor when the IGBTs are turned off. This is needed due to the inductance of the transformer primary windings. The firing of the two switch boards occurs during halves of a 50-microsecond interval, creating a constant 20 KHZ output. See the ***PULSE WIDTH MODULATION*** discussion in this section.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion

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FIGURE E-4 – DC BUS BOARD, POWER BOARD, FEED HEAD BOARD, GATEWAY BOARD AND VOLTAGE SENSE BOARD



DC BUS BOARD, POWER BOARD, FEED HEAD BOARD, GATEWAY BOARD AND VOLTAGE SENSE BOARD

The DC Bus Board receives approximately 65VDC from the Bus Board rectifier. The DC Bus Board regulates that 65VDC to a +40VDC supply. This regulated 40VDC is applied to the Feed Head Board, the Ethernet/Gateway Board, the Power Board, and the wire feeder receptacle.

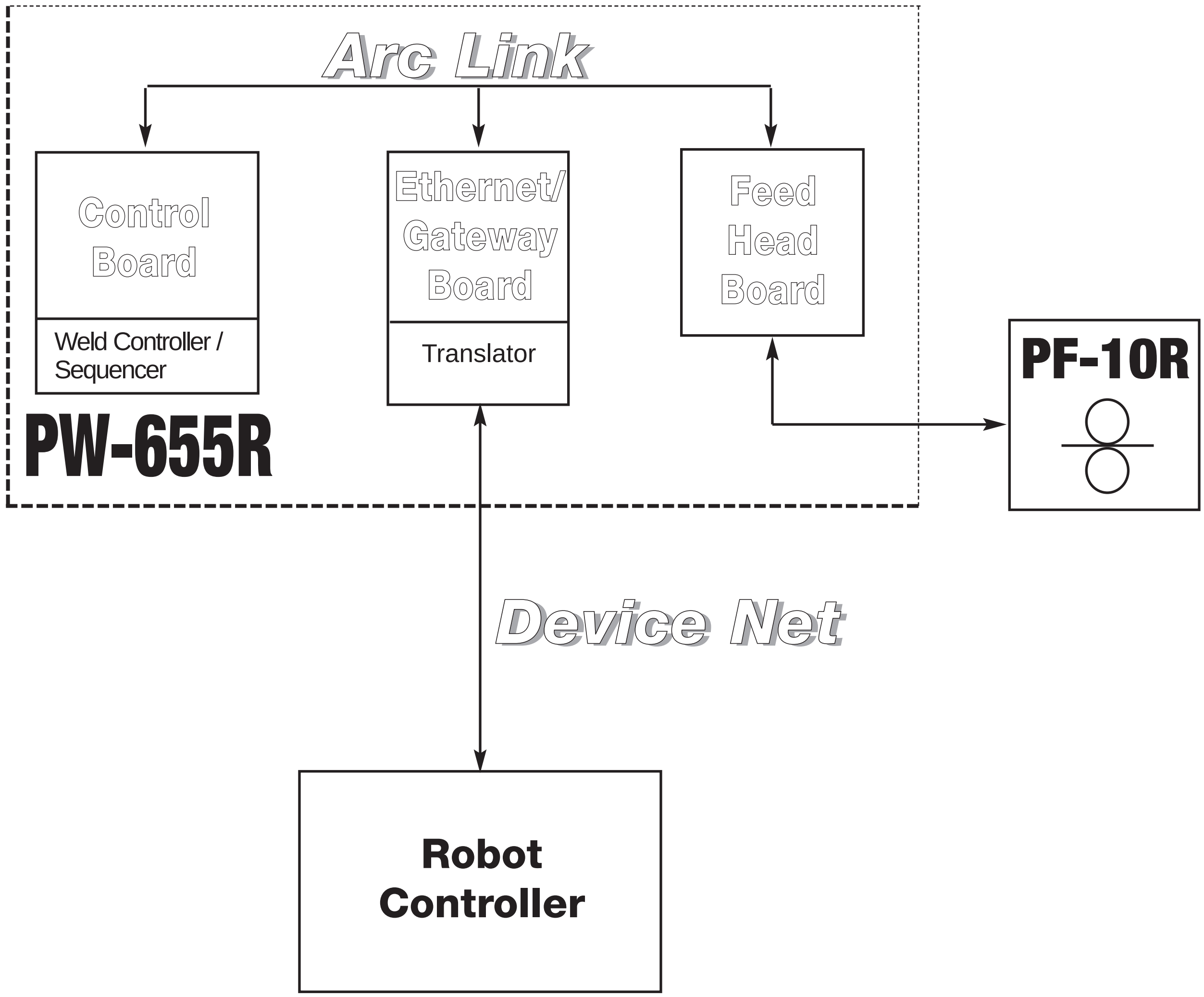
The switching power supplies on the Power Board supply a variety of regulated DC voltages to the Control Board. The Control Board uses these regulated voltages to power the many circuits and communication functions incorporated within the Control Board.

When the Feed Head Board activates the Voltage Sense Board, the actual arc voltage is sensed (lead 67), and this information is delivered through the voltage sense board to the Control Board.

The Power Wave 655R uses two digital communication platforms. Internally the PC boards communicate via ArcLink. Externally the Power Wave 655R communicates using the industry standard Ethernet or Device Net protocol.The Ethernet/Gateway Board makes the translation between the platforms possible. The Power Wave 655R does not have a dedicated interface device or board. The robot (or other input device – PLC, etc.) acts as the user interface, issuing commands that are translated by the Gateway Board to ArcLink compatible messages. ***Figure E.5*** depicts the flow of communication information.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion

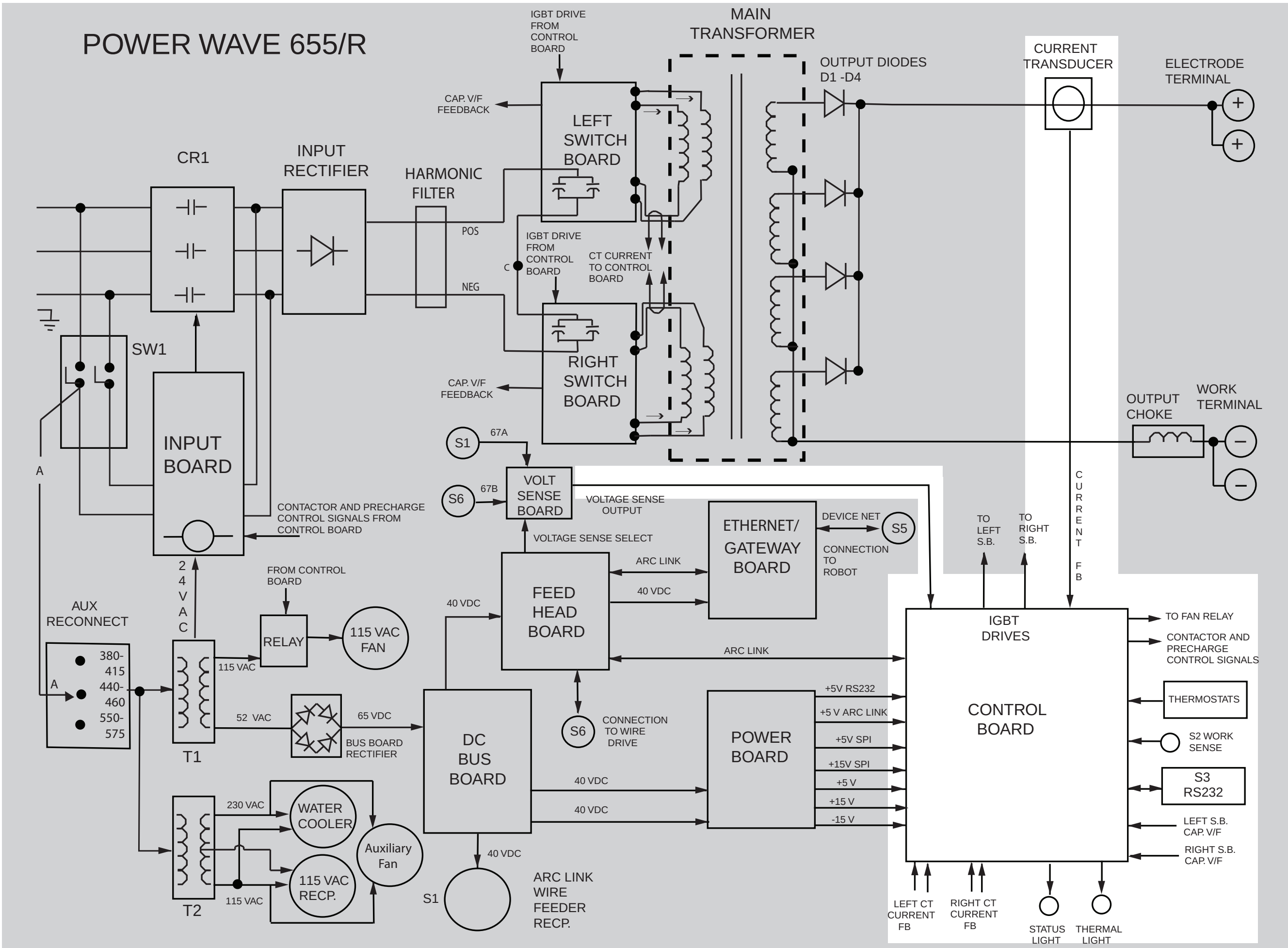
FIGURE E.5 – POWER WAVE 655/R COMMUNICATIONS



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FIGURE E.6 – CONTROL BOARD



CONTROL BOARD

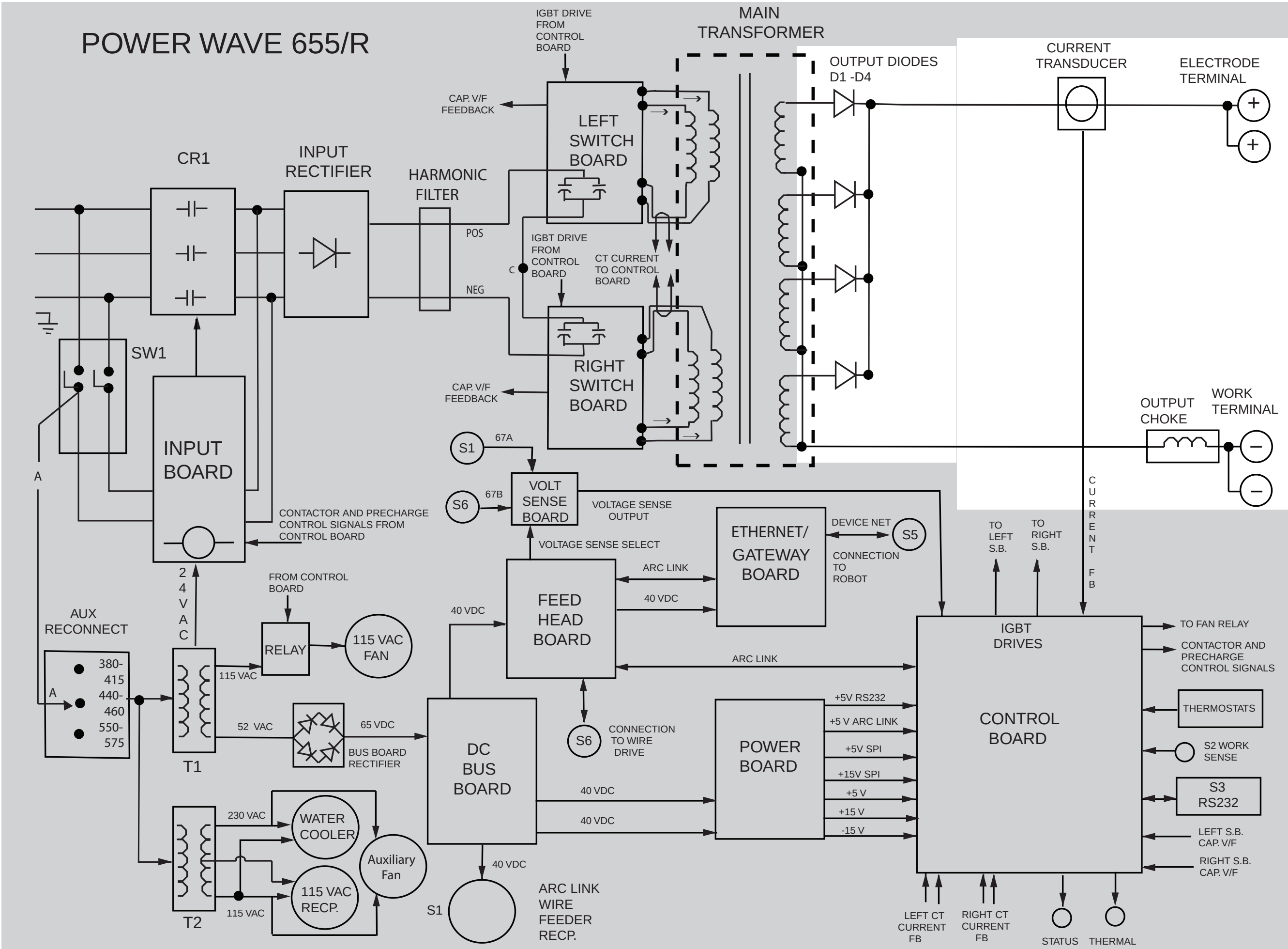
The Control Board performs the primary interfacing functions to establish and maintain output control of the Power Wave 655R machine. The function generator and weld files exist within the Control Board hardware and software. Digital command signals and arc voltage and current feedback information is received and processed by software located on the Control Board. The appropriate pulse width modulation (PWM) signals are then sent to the gates of the Switch Board IGBTs to create the high-speed, digitally controlled welding waveform. (See ***PULSE WIDTH MODULATION*** discussion in this section).

In addition, the Control Board monitors the thermostats, the main transformer primary currents and input filter capacitor voltages. Depending on the fault condition, the Control Board will activate the thermal and/or the status light and will either disable or reduce the machine output. In some conditions the input contactor will be de-energized.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion

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FIGURE E.7 – OUTPUT RECTIFIER, OUTPUT CHOKE AND STT CHOPPER BOARD



OUTPUT RECTIFIER, OUTPUT CHOKE

The output rectifier receives the AC output from the main transformer secondary and rectifies it to a DC voltage level. The output choke is in series with the negative leg of the output rectifier and also in series with the welding load. Due to the current "smoothing" capability of the output choke, a filtered DC output current is applied through the machine output terminals to the welding arc.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion

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THERMAL PROTECTION

Three normally closed (NC) thermostats protect the machine from excessive operating temperatures. These thermostats are wired in series and are connected to the control board. One of the thermostats is located on the heat sink of the output rectifier, one on the DC bus, and one on the output choke. Excessive temperatures may be caused by a lack of cooling air or by operating the machine beyond its duty cycle or output rating. If excessive operating temperatures should occur, the thermostats will prevent output from the machine. The yellow thermal light, located on the front of the machine, will be illuminated. The thermostats are self-resetting once the machine cools sufficiently. If the thermostat shutdown was caused by excessive output or duty cycle and the fan is operating normally, the power switch may be left on and the reset should occur within a 15-minute period. If the fan is not turning or the intake air louvers are obstructed, the power must be removed from the machine and the fan condition or air obstruction corrected. On later production machines (above code 10500) the cooling fan runs only when necessary. The F.A.N. (fan as needed) system is controlled by the Control Board via a solid state relay.

PROTECTIVE CIRCUITS

Protective circuits are designed into the Power Wave 655/R to sense trouble and shut down the machine before damage occurs to the machine's internal components. Error Codes will be flashed out by the Red/Green Status LED on the front panel and LED's on the Control Board to help identify the reason for the shutdown. See the Troubleshooting Section for more information regarding Error Codes. Fault codes can also be seen by using the Diagnostic Software.

OVER CURRENT PROTECTION

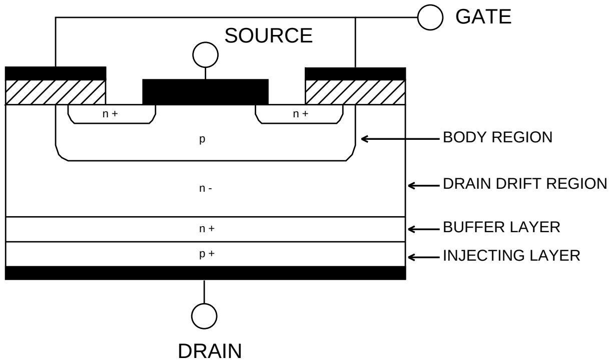
If the average weld current exceeds 880 amps, the peak current will be limited to 100 amps until the average current decreases to under 50 amps or the system is re-triggered.

UNDER/OVER VOLTAGE PROTECTION

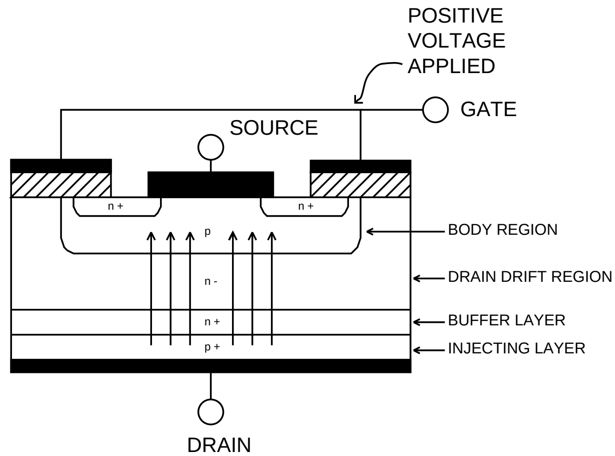
A protective circuit is included on the Control Board to monitor the voltage across the input capacitors. In the event that a capacitor voltage is too high, too low, or becomes unbalanced side-to-side, the protection circuit will de-energize the input contactor. Machine output will be disabled, and the "soft start" mode will be repeated. The protection circuit will prevent output if any of the following circumstances occur.

1. Capacitor conditioning is required. (This may be required if the machine has been off for a long period of time and is connected for high input voltage operation.)
2. Voltage across a capacitor exceeds 467 volts. (This could result from high line surges or improper input voltage connections.)
3. Voltage across a capacitor is under 70 volts. (This would be due to improper input voltage connections.)
4. Internal component damage.

FIGURE E.9 – IGBT OPERATION



A. PASSIVE



B. ACTIVE

INSULATED GATE BIPOLAR TRANSISTOR (IGBT) OPERATION

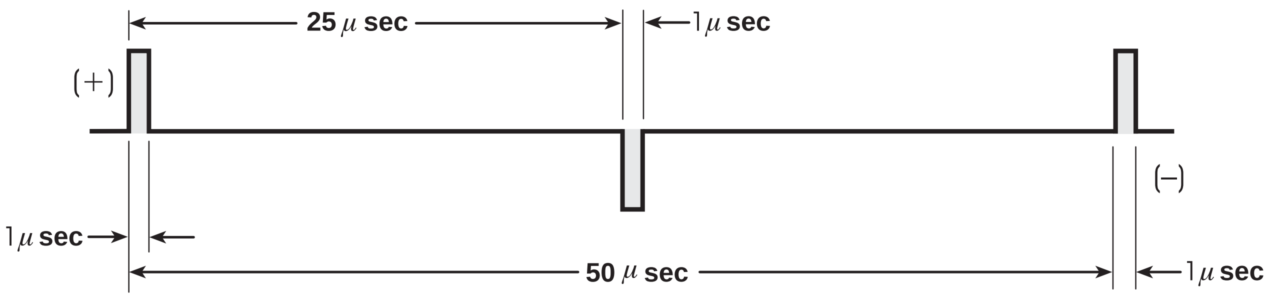
An IGBT is a type of transistor. IGBTs are semiconductors well suited for high frequency switching and high current applications.

Drawing A shows an IGBT in a passive mode. There is no gate signal, (zero volts relative to the source), and therefore, no current flow. The drain terminal of the IGBT may be connected to a voltage supply; but since there is no conduction, the circuit will not supply current to components connected to the source. The circuit is turned off like a light switch in the OFF position.

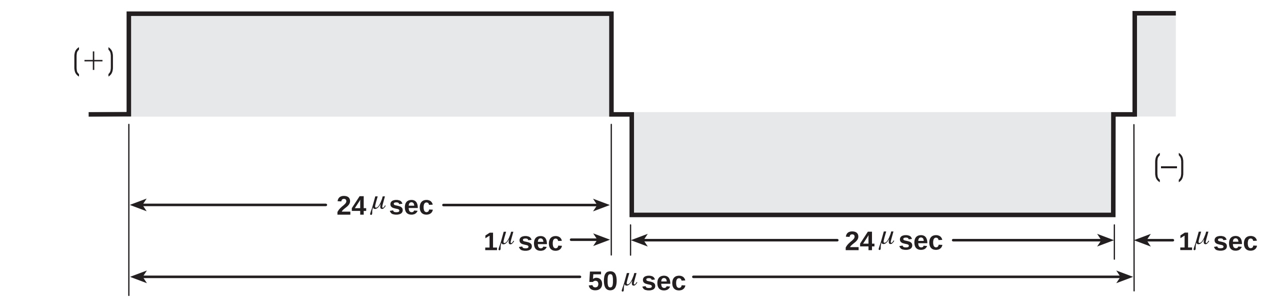
Drawing B shows the IGBT in an active mode. When the gate signal, a positive DC voltage relative to the source, is applied to the gate terminal of the IGBT, it is capable of conducting current. A voltage supply connected to the drain terminal will allow the IGBT to conduct and supply current to circuit components coupled to the source. Current will flow through the conducting IGBT to downstream components as long as the positive gate signal is present. This is similar to turning ON a light switch.

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FIGURE E.10 – TYPICAL IGBT OUTPUTS



MINIMUM OUTPUT



MAXIMUM OUTPUT

PULSE WIDTH MODULATION

The term PULSE WIDTH MODULATION (PWM) is used to describe how much time is devoted to conduction in the positive and negative portions of the cycle. Changing the pulse width is known as MODULATION. Pulse Width Modulation is the varying of the pulse width over the allowed range of a cycle to affect the output of the machine.

MINIMUM OUTPUT

By controlling the duration of the gate signal, the IGBT is turned on and off for different durations during a cycle. The top drawing shows the minimum output signal possible over a 50-microsecond time period.

The shaded portion of the signal represents one IGBT group[1], conducting for 1 microsecond. The negative portion is the other IGBT group. The dwell time (off time) is 48 microseconds (both IGBT groups off). Since only 2 microseconds of the 50-microsecond time period are devoted to conducting, the output power is minimized.

MAXIMUM OUTPUT

By holding the gate signals on for 24 microseconds each and allowing only 2 microseconds of dwell or off time (one microsecond during each half cycle) during the 50 microsecond cycle, the output is maximized. The darkened area under the minimum output curve can be compared to the area under the maximum output curve. The more darkened area, the more power is present.

[1] An IGBT group consists of the sets of IGBT modules grouped onto one switch board.

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HOW TO USE TROUBLESHOOTING GUIDE

⚠ WARNING

Service and Repair should only be performed by Lincoln Electric Factory Trained Personnel. Unauthorized repairs performed on this equipment may result in danger to the technician and machine operator and will invalidate your factory warranty. For your safety and to avoid Electrical Shock, please observe all safety notes and precautions detailed throughout this manual.

This Troubleshooting Guide is provided to help you locate and repair possible machine malfunctions. Simply follow the three-step procedure listed below.

Step 1. LOCATE PROBLEM (SYMPTOM).
Look under the column labeled "PROBLEM (SYMPTOMS)". This column describes possible symptoms that the machine may exhibit. Find the listing that best describes the symptom that the machine is exhibiting. Symptoms are grouped into the following categories: output problems, function problems, wire feeding problems, and welding problems.

Step 2. PERFORM EXTERNAL TESTS.
The second column labeled "POSSIBLE AREAS OF MISADJUSTMENT(S)" lists the obvious external possibilities that may contribute to the machine symptom. Perform these tests/checks in the order listed. In general, these tests can be conducted without removing the case wrap-around cover.

Step 3. RECOMMENDED COURSE OF ACTION
The last column labeled "Recommended Course of Action" lists the most likely components that may have failed in your machine. It also specifies the appropriate test procedure to verify that the subject component is either good or bad. If there are a number of possible components, check the components in the order listed to eliminate one possibility at a time until you locate the cause of your problem.

All of the referenced test procedures referred to in the Troubleshooting Guide are described in detail at the end of this chapter. Refer to the Troubleshooting and Repair Table of Contents to locate each specific Test Procedure. All of the specified test points, components, terminal strips, etc. can be found on the referenced electrical wiring diagrams and schematics. Refer to the Electrical Diagrams Section Table of Contents to locate the appropriate diagram.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact the Lincoln Electric Service Department for technical troubleshooting assistance before you proceed. Call 1-888-935-3877.

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PC BOARD TROUBLESHOOTING PROCEDURES

⚠ WARNING



ELECTRIC SHOCK can kill.

- Have an electrician install and service this equipment. Turn the input power OFF at the fuse box before working on equipment. Do not touch electrically hot parts.

⚠ CAUTION

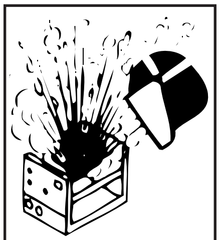
Sometimes machine failures appear to be due to PC board failures. These problems can sometimes be traced to poor electrical connections. To avoid problems when troubleshooting and replacing PC boards, please use the following procedure:

1. Determine to the best of your technical ability that the PC board is the most likely component causing the failure symptom.

2. Check for loose connections at the PC board to assure that the PC board is properly connected.

3. If the problem persists, replace the suspect PC board using standard practices to avoid static electrical damage and electrical shock. Read the warning inside the static resistant bag and perform the following procedures:

PC board can be damaged by static electricity.



ATTENTION Static-Sensitive Devices Handle only at Static-Safe Workstations

- Remove your body's static charge before opening the static-shielding bag. Wear an anti-static wrist strap. For safety, use a 1 Meg ohm resistive cord connected to a grounded part of the equipment frame.

- If you don't have a wrist strap, touch an un-painted, grounded, part of the equipment frame. Keep touching the frame to prevent static build-up. Be sure not to touch any electrically live parts at the same time.

- Tools which come in contact with the PC board must be either conductive, anti-static or static-dissipative.

- Remove the PC board from the static-shielding bag and place it directly into the equipment. Don't set the PC board on or near paper, plastic or cloth which could have a static charge. If the PC board can't be installed immediately, put it back in the static-shielding bag.

- If the PC board uses protective shorting jumpers, don't remove them until installation is complete.

- If you return a PC board to The Lincoln Electric Company for credit, it must be in the static-shielding bag. This will prevent further damage and allow proper failure analysis.

4. Test the machine to determine if the failure symptom has been corrected by the replacement PC board.

NOTE: It is desirable to have a spare (known good) PC board available for PC board troubleshooting.

NOTE: Allow the machine to heat up so that all electrical components can reach their operating temperature.

5. Remove the replacement PC board and substitute it with the original PC board to recreate the original problem.

   a. If the original problem does not reappear by substituting the original board, then the PC board was not the problem. Continue to look for bad connections in the control wiring harness, junction blocks, and terminal strips.

   b. If the original problem is recreated by the substitution of the original board, then the PC board was the problem. Reinstall the replacement PC board and test the machine.

6. Always indicate that this procedure was followed when warranty reports are to be submitted.

NOTE: Following this procedure and writing on the warranty report, "INSTALLED AND SWITCHED PC BOARDS TO VERIFY PROBLEM," will help avoid denial of legitimate PC board warranty claims.

USING THE STATUS LED TO TROUBLESHOOT SYSTEM PROBLEMS

The Power Wave / Power Feed are best diagnosed as a system. Each component (power source, user interface, and feed head) has a status light, and when a problem occurs it is important to note the condition of each. In addition, errors displayed on the user interface in most cases indicate only that a problem exists in the power source, not what the problem may be.

Therefore, prior to cycling power to the system, check the power source status light for error sequences as noted below. This is especially important if the user interface displays "Err 006" or "Err 100" .

Included in this section is information about the power source Status LED, and some basic troubleshooting charts for both machine and weld performance.
The STATUS LIGHT is a two color light that indicates system errors. Normal operation is a steady green light. Error conditions are indicated in the following chart.

NOTE: The Power Wave status light will flash green, and sometimes red and green, for up to one minute when the machine is first turned on. This is a normal situation as the machine goes through a self test at power up.

LIGHT CONDITION	MEANING
Status LED is solid green (no blinking).	1. System OK. Power source communicating normally with wire feeder and its components.
Status LED is blinking green.	2. Occurs during a reset, and indicates the Power Wave 455M (CE) is mapping (identifying) each component in the system. Normal for first 1-10 seconds after power is turned on, or if the system configuration is changed during operation.
Status LED is blinking red and green.	3. Non-recoverable system fault. If the PS Status light is flashing any combination of red and green, errors are present in the Power Wave 455M (CE). **Read the error code before the machine is turned off.** Error Code interpretation through the Status light is detailed in the Service Manual. Individual code digits are flashed in red with a long pause between digits. If more than one code is present, the codes will be separated by a green light. To clear the error, turn power source off, and back on to reset.
Status LED is solid red (no blinking).	Not Applicable
Status LED is blinking red.	Not applicable.

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ERROR CODES FOR THE POWER WAVE

The following is a list of possible error codes that the Power Wave 655 can output via the status light If connected to a PF-10/11 these error codes will generally be accompanied by an "Err 006" or "Err 100" on the user interface display.

Error Code #		Indication
11	CAN communication bus off.	Probably due to excessive number of communication errors.
12	User Interface time out error.	UI is no longer responding to the Power Source. The most likely cause is a fault/bad connection in the communication leads or control cable.
21	Unprogrammed Weld Mode.	Contact the Service Department or *powerwavesoftware.com* for instructions on reloading the Welding Software.
22	Empty Weld Table.	Contact the Service Department or *powerwavesoftware.com* for instructions on reloading the Welding Software.
23	Weld Table checksum error.	Contact the Service Department or *powerwavesoftware.com* for instructions on reloading the Welding Software..
31	Primary overcurrent error.	Excessive Primary current present. May be related to a short in the main transformer or output rectifier.
32	Capacitor "A" under voltage (Left side facing machine)	Low voltage on the main capacitors. May be caused by improper input configuration.
33	Capacitor "B" under voltage (Right side facing machine)	When accompanied by an overvoltage error on the same side, it indicates no capacitor voltage present on that side, and is usually the result of an open or short in the primary side of the machine.
34	Capacitor "A" over voltage (Left side facing machine)	Excess voltage on the main capacitors. May be caused by improper input configuration.
35	Capacitor "B" over voltage (Right side facing machine)	When accompanied by an under voltage error on the same side, it indicates no capacitor voltage present on that side, and is usually the result of an open or short in the primary side of the machine.
36	Thermal error	Indicates over temperature. Usually accompanied by Thermal LED. Check fan operation. Be sure process does not exceed duty cycle limit of the machine.
37	Soft start error	Capacitor precharge failed. Usually accompanied by codes 32-35.
41	Secondary overcurrent error	The secondary (weld) current limit has been exceeded. When this occurs the machine output will phase back to 100 amps, typically resulting in a condition referred to as "noodle welding" NOTE: The secondary limit is 570 amps for the standard stud, and 325 amps.
43	Capacitor delta error	The maximum voltage difference between the main capacitors has been exceeded. May be accompanied by errors 32-35.
49	Single phase error	Indicates machine is running on single phase input power. Usually caused by the loss of the middle leg (L2).
Other		Error codes that contain three or four digits are defined as fatal errors. These codes generally indicate internal errors on the PS Control Board. If cycling the input power on the machine does not clear the error, try reloading the latest version operating system (available at *powerwavesoftware.com*). If this fails, contact the Service Department at 1-888-935-3877

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Major physical or electrical damage is evident when the sheet metal covers are removed.	Contact your local authorized Lincoln Electric Field Service Facility for technical assistance.	Contact the Lincoln Electric Service Department at 1-888-935-3877
The input fuses repeatedly fail or the input circuit breakers keep tripping.	1. Make certain the fuses or breakers are properly sized. 2. Make certain the reconnect panel is configured properly for the applied voltage. 3. The welding procedure may be drawing too much input current or the duty cycle may be too high. Reduce the welding current and/or reduce the duty cycle.	1. Check the reconnect switches and associated wiring. See the Wiring Diagram. 2. Perform the ***Input Rectifier Test.*** 3. Perform the ***Switch Board Test.*** 4. Perform the ***Input Contactor Test.***

CAUTION

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact the Lincoln Electric Service Department for technical troubleshooting assistance before you proceed. Call 1-888-935-3877.

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Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
The machine is dead—no lights—no output—the machine appears to be off.	1. Make certain the input power switch SW1 is in the ON position. 2. Check the main input fuses (or breakers). If open, replace or reset. 3. Check the 6 amp CB4 breaker located in the reconnect area. Reset if tripped. 4. Make certain the reconnect panel is configured correctly for the applied input voltage.	1. Check the input power switch SW1 for proper operation. Also check the associated leads for loose or faulty connections. See the Wiring Diagram. 2. Check circuit breaker CB4 for proper operation 3. Perform the ***T1 Auxiliary Transformer Test.*** 4. The power board rectifier may be faulty. Check rectifier and associated wiring. See the Wiring Diagram. 5. Perform the ***DC Buss Board Test.*** 6. Perform the ***Power Board Test.*** 7. The Control Board may be faulty.

CAUTION

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact the Lincoln Electric Service Department for technical troubleshooting assistance before you proceed. Call 1-888-935-3877.

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
The Power Wave 655/R does not have welding output. The main input contactor CR1 is not activating.	1. Turn the input power off and make certain the reconnect panel is configured correctly for the applied input voltage. 2. If the Thermal light is lit, the unit may be overheated. Let the machine cool and adjust welding load and/or duty cycle to coincide with the output limits of the machine.	1. Perform the ***Input Contactor Test.*** 2. Perform the ***Input Board Test.*** 3. Perform the ***T1 Auxiliary Transformer Test.*** 4. Perform the ***Input Rectifier Test.*** 5. Perform the ***Switch Board Test.*** 6. Perform the ***Power Board Test.*** 7. The Control Board may be faulty.
The thermal light is lit. The machine regularly "overheats."	1. The welding application may be exceeding the recommended duty cycle and/or current limits of the machine. 2. Dirt and dust may have clogged the cooling channels inside the machine. Refer to the ***Maintenance Section*** of this manual. 3. Air intake and exhaust louvers may be blocked due to inadequate clearance around the machine. 4. Make sure the fan is functioning correctly. Machines above code 10500 are equipped with F.A.N. (fan as needed) circuitry. The fan runs whenever the output is enabled, whether under load or open circuit conditions. The fan also runs for a period of time (approximately 5 minutes) after the output is disabled.	1. One of the thermostats may be faulty. Also check associated wiring for loose or faulty connections. See the Wiring Diagram.

CAUTION

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact the Lincoln Electric Service Department for technical troubleshooting assistance before you proceed. Call 1-888-935-3877.

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The machine often "noodle welds" when running a particular process. The output is limited to approximately 100 amps.	1. The machine may be trying to deliver too much power. When the average output current exceeds 570 amps, the machine will "phase back" to protect itself. Adjust the procedure or reduce the load to lower the current draw from the Power Wave 655/R machine.	1. Perform the ***Current Transducer Test.*** 2. The Control Board may be faulty.
The Power Wave 655/R will not produce full output.	1. The input voltage may be too low, limiting the output capability of the machine. Make certain the input voltage is correct for the machine and the reconnect panel configuration. 2. Make sure all three phases of input power are being applied to the machine.	1. Perform the ***Output Rectifier Test.*** 2. Perform the ***Current Transducer Test.*** 3. Perform the ***Power Board Test.*** 4. The Control Board may be faulty.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact the Lincoln Electric Service Department for technical troubleshooting assistance before you proceed. Call 1-888-935-3877.

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Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The Auxiliary Receptacle is "dead." The 120VAC is not present at the receptacle.	1. Check the 10 amp circuit breaker (CB2) located on the case front. Reset if necessary. 2. Check the 6 amp circuit breaker (CB4) located in the reconnect area. Reset if necessary. 3. Make sure all three phases of input power are being applied to the machine.	1. Check the receptacle and associated wiring for loose or faulty connections. See the Wiring Diagram. 2. Perform the ***T2 Auxiliary Transformer Test.***
The Power Wave 655/R is "triggered" for output but there is no welding output.	1. Make sure that the triggering method and device is correct and operating properly. 2. Check circuit breaker CB4. Reset if tripped.	Use the Diagnostic Software to locate the problem. The latest software and the Diagnostic Utilities software is available at *powerwavesoftware.com.*

CAUTION

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact the Lincoln Electric Service Department for technical troubleshooting assistance before you proceed. Call 1-888-935-3877.

INPUT FILTER CAPACITOR DISCHARGE PROCEDURE

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

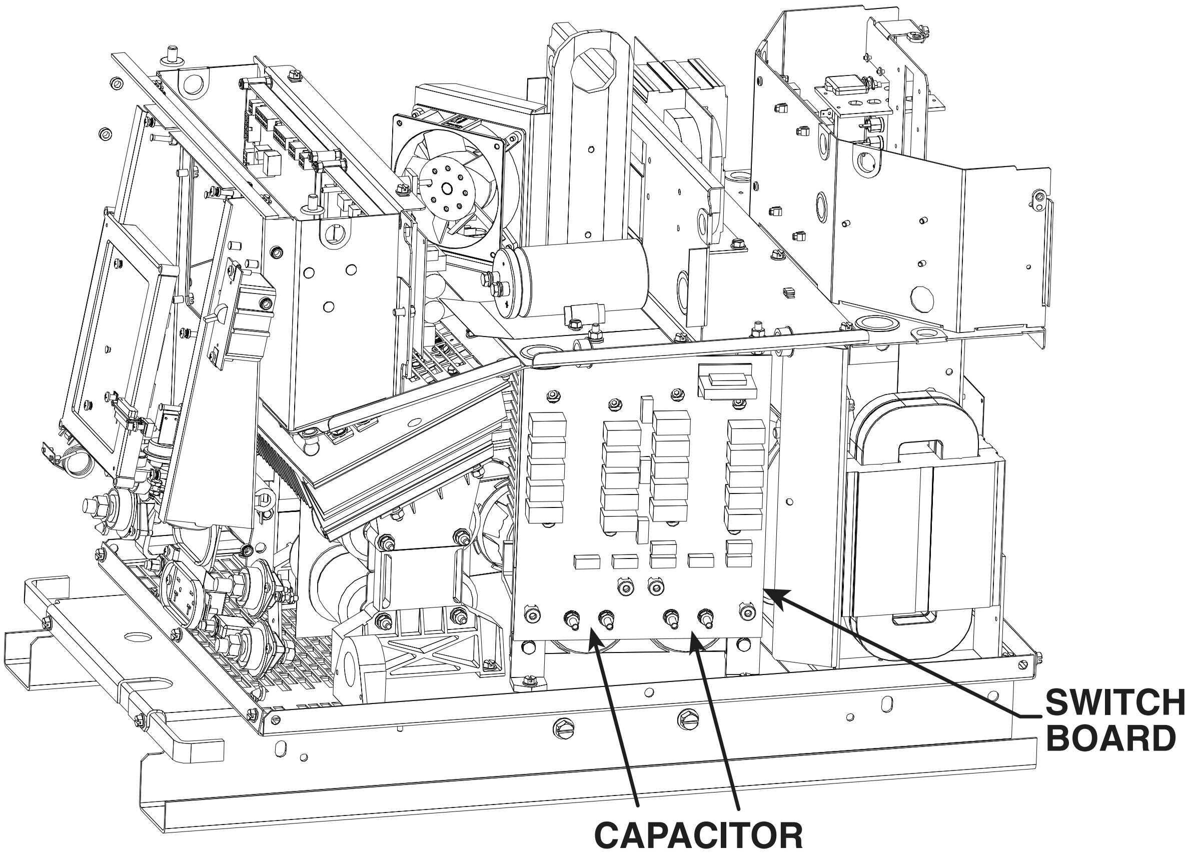
This "safety" procedure should be performed before any internal maintenance or repair procedures are attempted on the POWER WAVE 655/R. Capacitors normally discharge within 2 minutes of removing input power. This procedure is used to check that the capacitors have properly discharged.

MATERIALS NEEDED

Misc. hand tools
Volt-ohmmeter
25-1000 ohms @ 25 watts (minimum) resistor
Electrically insulated gloves and pliers

INPUT FILTER CAPACITOR DISCHARGE PROCEDURE *(CONTINUED)*

FIGURE F.1 – CAPACITOR DISCHARGE PROCEDURE



PROCEDURE

1. Disconnect the input power to the POWER WAVE 655/R.
2. Remove the left and right case sides.
3. Remove the two High Voltage Protection shields. Be careful not to touch the capacitor terminals that are located at the bottom of the left and right side switch boards.
4. With a voltmeter, carefully check for a DC voltage at the capacitor terminals of both boards. Note the polarity as marked on the PC board.
5. If any voltage is present, proceed to Step #6. If no voltage is present, the capacitors are discharged.

NOTE: Normally the capacitors discharge with-in about two minutes after input power is removed.

6. Using the high wattage resistor (25-1000 ohms @ 25 watts), with electrically insulated gloves and pliers, touch the resistor across the two capacitor terminals. Hold the resistor in place for 10 seconds. DO NOT TOUCH THE CAPACITOR TERMINALS WITH YOUR BARE HANDS. **NEVER USE A SHORTING STRAP FOR THIS PROCEDURE.**
7. Repeat procedure for the other capacitors.
8. Recheck the voltage across the capacitor terminals. The voltage should be zero. If any voltage remains, repeat the discharge procedure.

NOTE: If the capacitor voltage is present after the discharge has been performed, this may indicate a faulty switch board.

SWITCH BOARD TEST PROCEDURE

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will help determine if the “power section” of the switch boards are functioning correctly. This test will NOT indicate if the entire PC board is functional. This resistance test is preferable to a voltage test with the machine energized because these boards can be damaged easily. In addition, it is dangerous to work on these boards with the machine energized.

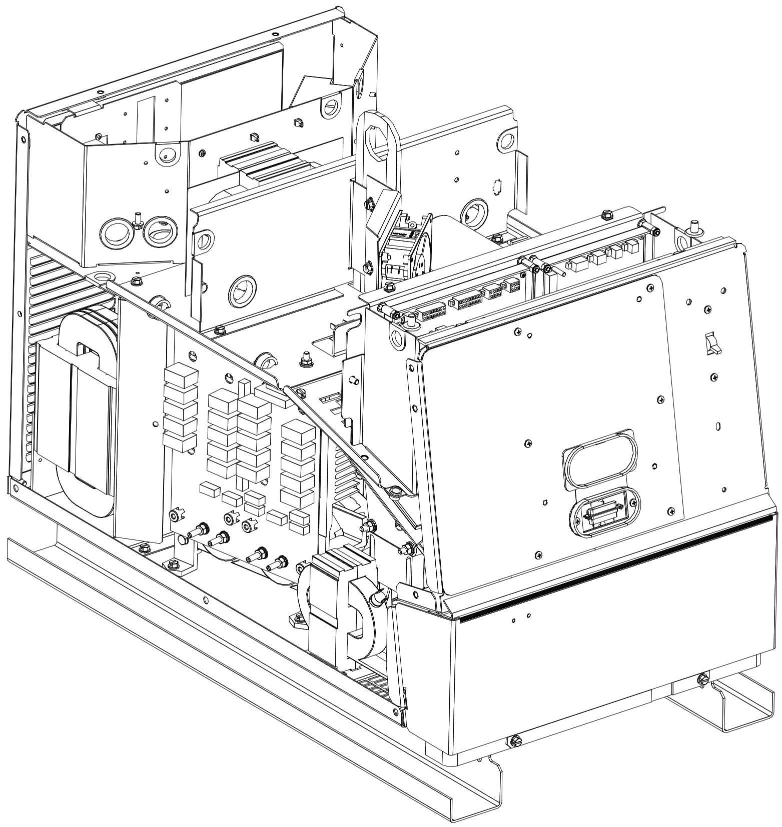
MATERIALS NEEDED

Misc. Hand Tools
Torque Wrench
Volt-ohmmeter
Wiring Diagram

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SWITCH BOARD TEST PROCEDURE *(CONTINUED)*

FIGURE F.2 – LEFT SIDE



NOTE: Resistance checks of the Switch Boards in this machine will vary greatly depending on the type and model of meter being used. Comparative readings between the two sides of a board and/or between the two Switch Boards will be more meaningful than the actual numbers. In all cases, readings of all sets of test points should be approximately the same. If not using an 'auto-ranging' meter, select the X1000 scale.

The readings in ***Table F.1*** are representative of the meters available when this test was developed.

PROCEDURE

1. Disconnect the input power to the POWER WAVE 655/R.
2. Remove the case sides.
3. Perform the ***Capacitor Discharge*** Procedure.
4. Using the volt-ohmmeter, perform the resistance tests detailed in ***Table F.1.*** The readings should all be similar. One or more readings that vary considerably will usually indicate a defective board. Refer to ***Figures F.2 and F.3*** for the test points
5. If any test fails replace the Switch Board. See ***Switch Board Removal and Replacement.***

NOTE: Switch boards should have Identical base numbers and dash numbers.

6. If the switch board resistance tests are OK, check the molex pin connections and associated wiring from the switch boards to the control board. See the Wiring Diagram.

SWITCH BOARD TEST PROCEDURE *(CONTINUED)*

FIGURE F.3 – RIGHT SIDE AND TEST POINTS

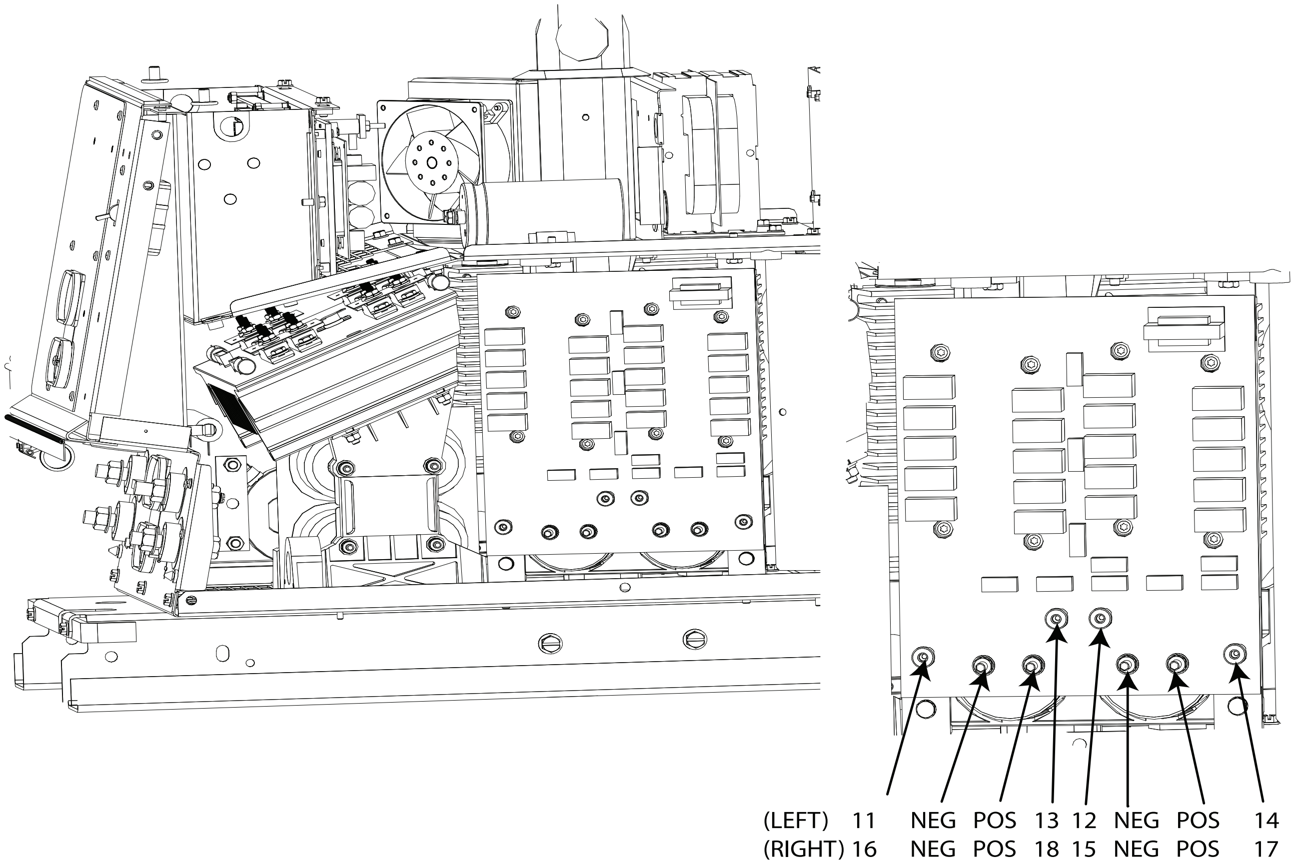


TABLE F.1 – SWITCH BOARD RESISTANCE TEST POINTS

POSITIVE METER PROBE	NEGATIVE METER PROBE	DIGITAL METER (TYPICAL)	ANALOG METER (X1000) TYPICAL
POS (19)	11(16) or 13(18)	> .5 MΩ	>5kΩ
POS (21)	12(15) or 14(17)	> .5 MΩ	>5kΩ
11(16) or 13(18)	POS (19)	< .5 MΩ	<2kΩ
12(15) or 14(17)	POS (21)	< .5 MΩ	<2kΩ
NEG (20)	11(16) or 13(18)	< .5 MΩ	<2kΩ
NEG (22)	12(15) or 14(17)	< .5 MΩ	<2kΩ
11(16) or 13(18)	NEG (20)	> .5 MΩ	>5kΩ
12(15) or 14(17)	NEG (22)	> .5 MΩ	>5kΩ

NOTE: A suspect board should be re-checked after removal from the machine. The actual readings may be different at that time but all similar test points should be comparable. If not, the board is probably defective.

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INPUT RECTIFIER TEST PROCEDURE

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will help determine if the input rectifier has “shorted” or “open” diodes.

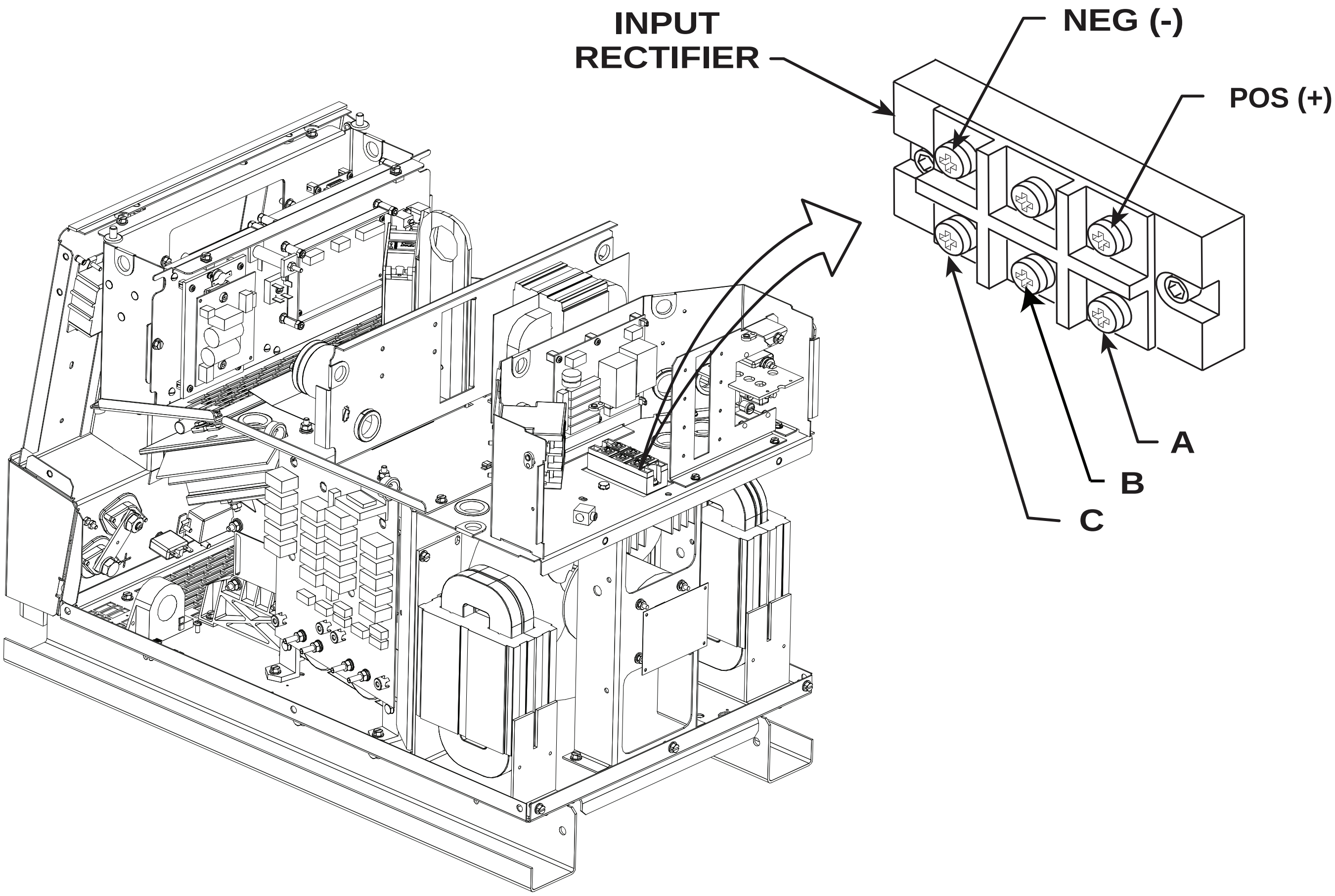
MATERIALS NEEDED

Analog volt-ohmmeter
Misc. Hand Tools
Wiring Diagram

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INPUT RECTIFIER TEST PROCEDURE *(CONTINUED)*

FIGURE F.4 – INPUT RECTIFIER TEST



PROCEDURE

1. Disconnect the input power to the POWER WAVE 655/R.
2. Remove the case top and Input Panel.
3. Perform the ***Capacitor Discharge*** Procedure.
4. Locate the Input Rectifier and lead locations. Refer to Figure F.4.
5. Use an ohmmeter to perform the tests detailed in ***Table F.2***.
6. If the rectifier does not meet the expected readings,remove the POS. and NEG leads and retest. If it still fails the test it should be replaced.

NOTE: Some of the RTV material will have to be removed. The terminals should be resealed with RTV when testing or replacement is complete.

9. See the ***Input Rectifier Removal and Replacement*** procedure for proper torque settings when re-connecting the leads to the rectifier.
10. Before installing a new rectifier, perform the ***Switch Board*** test and the ***Input Contactor*** test.
11. Replace the case top and input panel.

INPUT RECTIFIER TEST PROCEDURE *(CONTINUED)*

TABLE F.2 – INPUT RECTIFIER TEST POINTS AND ACCEPTABLE READINGS

TEST POINT TERMINALS		ANALOG METER X100 RANGE
+ Probe	**- Probe**	**Acceptable Meter Readings**
A	NEG (F)	Greater than 1000 ohms
B	NEG (F)	Greater than 1000 ohms
C	NEG (F)	Greater than 1000 ohms
A	POS (D)	Approx. 500 ohms
B	POS (D)	Approx. 500 ohms
C	POS (D)	Approx. 500 ohms
NEG	A	Approx. 500 ohms
NEG	B	Approx. 500 ohms
NEG	C	Approx. 500 ohms
POS	A	Greater than 1000 ohms
POS	B	Greater than 1000 ohms
POS	C	Greater than 1000 ohms

NOTE: Digital meters may not provide enough current in the “ohms” mode to achieve the readings indicated. They will, however, indicate whether the device is shorted (typical failure mode) or open. A ‘shorted’ device will usually read a low resistance (<100Ω) in both polarities. An ‘open’ device will read as if the meter leads were not connected to anything (typically “OL”) in both polarities.

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INPUT CONTACTOR TEST PROCEDURE

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will help determine if the input contactor is functional and if the contacts are functioning correctly.

MATERIALS NEEDED

Misc. Hand Tools
Volt-ohmmeter
External 24 VAC supply

INPUT CONTACTOR TEST PROCEDURE *(CONTINUED)*

FIGURE F.5 – INPUT CONTACTOR COIL

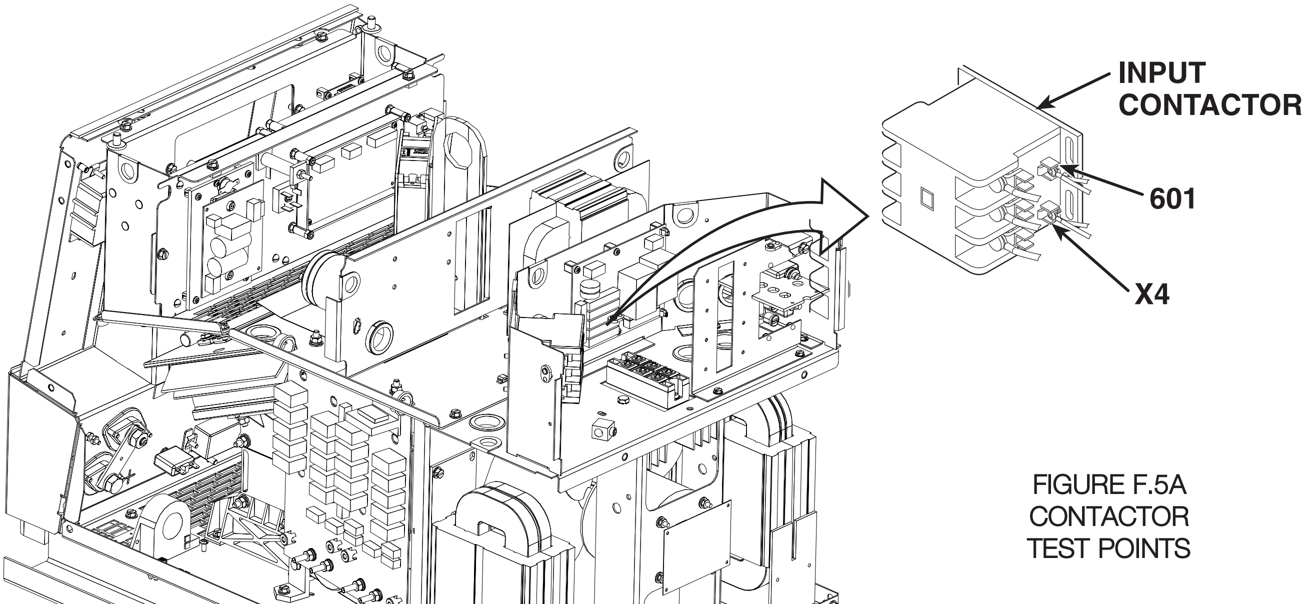
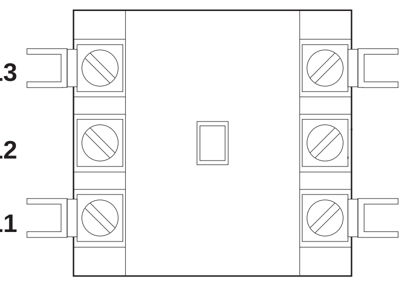


FIGURE F.5A
CONTACTOR
TEST POINTS



PROCEDURE

1. Disconnect the input power to the POWER WAVE 655/R.
2. Remove the input access panel and case top.
3. Locate, mark, and remove the two leads (601, X4) that are connected to the input contactor coil. Refer to Figure F.5.
4. Use an ohmmeter to check the resistance of the coil. It should be approximately 6Ω.
5. Check the resistance across the contacts: Refer to Figure F.5A

   L1 to T1 , L2 to T2 and L3 to T3.
   All three readings should show “open”

   If the resistance is low, the input contactor is faulty.

6. Press in on the “test button” and recheck the contacts as in Step 5.

NOTE: If a 24 vac supply is available, it can be connected to the coil terminals to activate the contactor, instead of using the Test Button.

   All readings should be very close to 0Ω If the resistance is high, the input contactor is faulty.

7. Reconnect the two leads (601, X4) to the input contactor coil.
8. Replace the input access door and case top.

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DC BUS BOARD TEST PROCEDURE

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will determine if the DC Bus PC Board is receiving and processing the proper voltages.

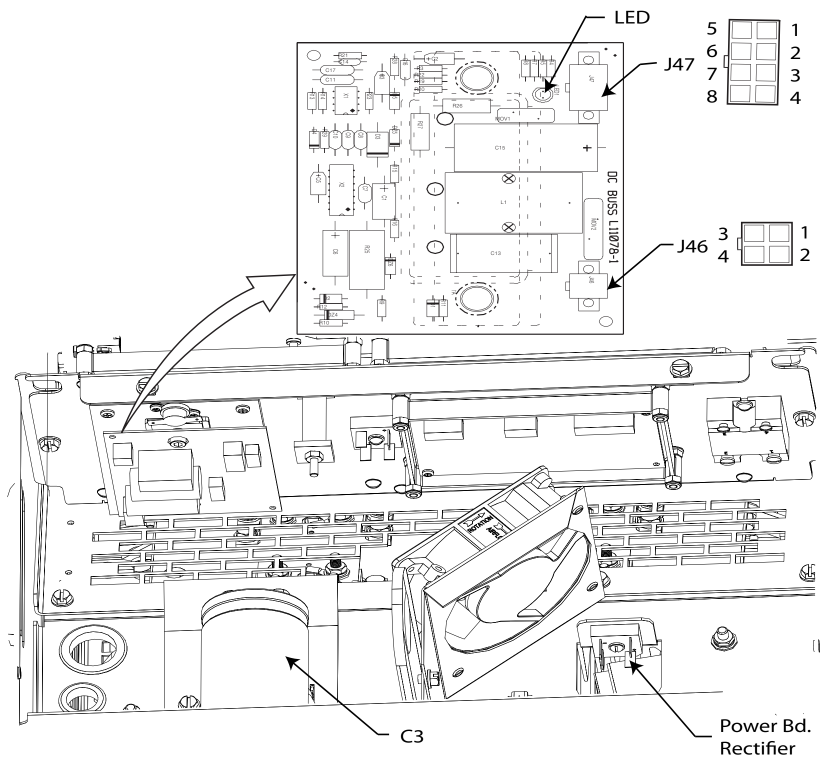
MATERIALS NEEDED

Misc. Hand Tools
Volt/ohmmeter
Wiring Diagram

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DC BUS BOARD TEST PROCEDURE *(CONTINUED)*

FIGURE F.6 – DC BUS PC BOARD



PROCEDURE

1. Disconnect the input power from the machine.
2. Remove the case top.
3. Locate the DC Bus PC Board and plugs P46 and P47. See Figure F.6.
4. Carefully apply input power to the POWER WAVE 655/R.

⚠ WARNING



ELECTRIC SHOCK can kill.

High voltage is present when input power is applied to the machine.

5. Turn on the POWER WAVE 655/R. The LED on the DC Bus Board should light.

   If the LED does not light, check the input voltage to the board at the terminals of the capacitor C-3. It should read 65-75vdc.

6. If the input voltage is correct the DC Bus Board may be defective. If not, check the Power Board Rectifier and the Auxiliary Transformer T1.
7. Check the Bus Board output voltages at P47 per Table F.3.

TABLE F.3 - DC Bus Bd Output Voltages

Positive Meter Probe	Negative Meter Probe	Voltage Reading (vdc)	
Pin 7	Pin 6	38 to 42	to Power PC Bd.
Pin 8	Pin 6	38 to42	to Power PC Bd.
Pin 4	Pin 2	38 to 42	to Feed Head Bd.
Pin 3	Pin 1	38 to 42	to S1 - Wire Feeder Receptacle

8. If any of the readings is incorrect, replace the board.
9. Disconnect the input power and replace the case top.

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POWER BOARD TEST PROCEDURE

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will help determine if the Power Board is receiving the correct voltages and also if the Power Board is regulating and producing the correct DC voltages.

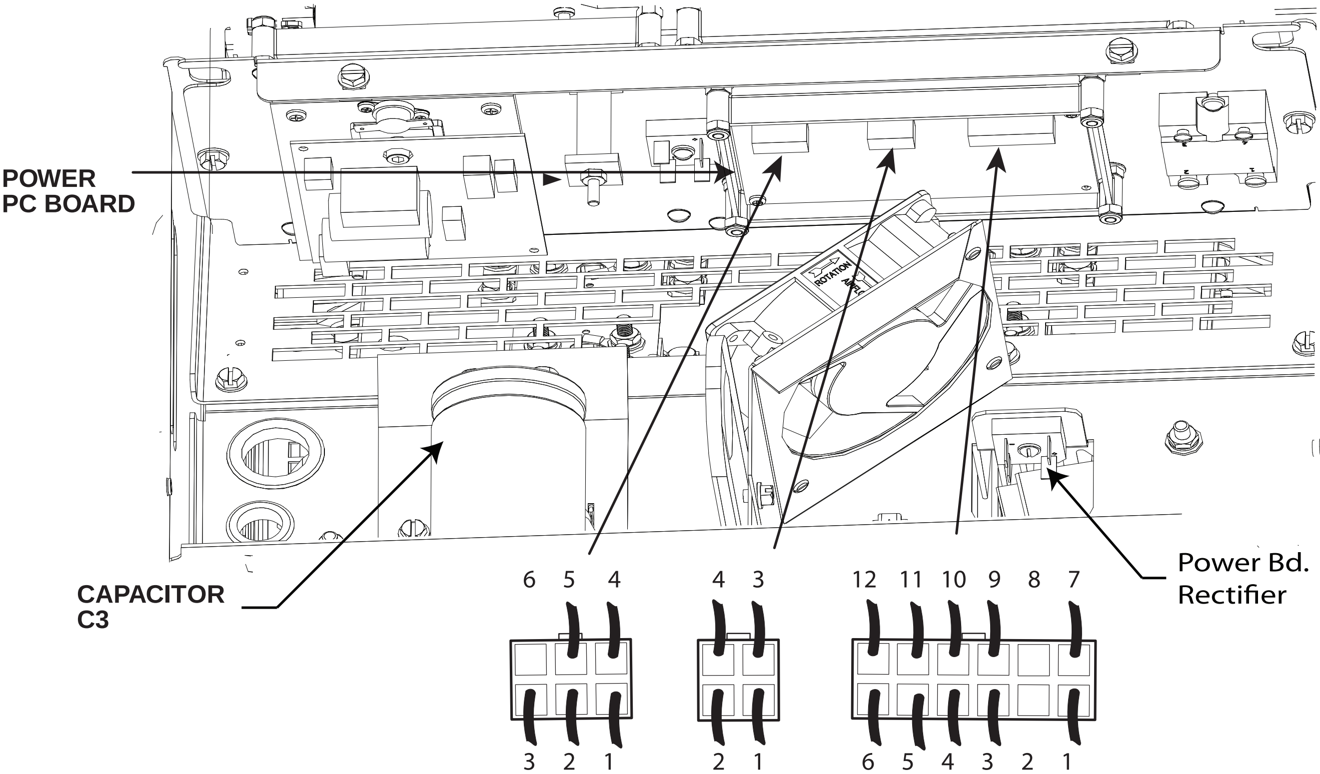
MATERIALS NEEDED

Misc. Hand Tools
Volt-ohmmeter
Wiring Diagram

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POWER BOARD TEST PROCEDURE *(CONTINUED)*

FIGURE F.7 – POWER BOARD TEST



PROCEDURE

1. Disconnect the input power to the POWER WAVE 655/R.
2. Remove the case top.
3. Locate the Power Board and plugs J42 and J43. **Do not remove plugs or leads from the Power Board**. Refer to Figure F.7.
4. Carefully apply input power to the POWER WAVE 655/R.

WARNING



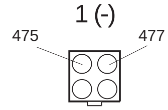
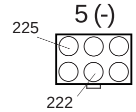
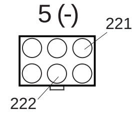
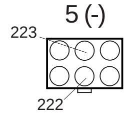
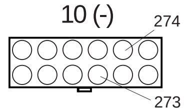
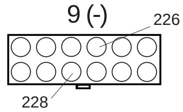
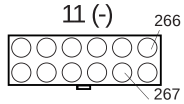
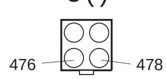
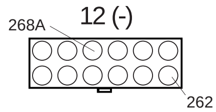
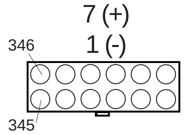
ELECTRIC SHOCK can kill. High voltage is present when input power is applied to the machine.

5. Turn on the POWER WAVE 655/R. Carefully test for the correct voltages at the Power Board according to ***Table F.4.***
6. If either of the 40 VDC voltages is low or not present at plug J41, perform the ***DC Bus PC Board Test***. See the Wiring Diagram. Also perform the ***T1 Auxiliary Transformer Test.***
7. If any of the DC voltages are low or not present at plugs J42 and/or J43, the Power Board may be faulty.
8. Replace the case top.

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POWER BOARD TEST PROCEDURE *(CONTINUED)*

TABLE F.4 – POWER BOARD VOLTAGE CHECKS

CHECK POINT LOCATION	TEST DESCRIPTION	CONNECTOR PLUG PIN NO.	LEAD NO. OR IDENTITY	NORMAL ACCEPTABLE VOLTAGE READING
POWER BOARD CONNECTOR PLUG J41	CHECK 40 VDC INPUT FROM DC BUS BOARD	2 (+) 1 (-) 	477 (+) 475 (-)	38 – 42 VDC
POWER BOARD CONNECTOR PLUG J42	CHECK +15 VDC SUPPLY FROM POWER BOARD	1 (+) 5 (-) 	225 (+) 222 (-)	+15 VDC
POWER BOARD CONNECTOR PLUG J42	CHECK +5 VDC SUPPLY FROM POWER BOARD	3 (+) 5 (-) 	221 (+) 222 (-)	+5 VDC
POWER BOARD CONNECTOR PLUG J42	CHECK -15 VDC SUPPLY FROM POWER BOARD	2 (+) 5 (-) 	222 (+) 223 (-)	-15 VDC
POWER BOARD CONNECTOR PLUG J43	CHECK +5 VDC ARCLINK SUPPLY FROM POWER BOARD	5 (+) 10 (-) 	274 (+) 273 (-)	+5 VDC
POWER BOARD CONNECTOR PLUG J43	CHECK +5 VDC “RS-232” SUPPLY FROM POWER BOARD	4 (+) 9 (-) 	226 (+) 228 (-)	+5 VDC
POWER BOARD CONNECTOR PLUG J43	CHECK +15 VDC SPI SUPPLY FROM POWER BOARD	6 (+) 11 (-) 	266 (+) 267 (-)	+15 VDC
POWER BOARD CONNECTOR PLUG J41	CHECK +40 VDC INPUT FROM DC BUS BOARD	4 (+) 3 (-) 	478 (+) 476 (-)	38 – 42 VDC
POWER BOARD CONNECTOR PLUG J43	CHECK +5 VDC SPI SUPPLY FROM POWER BOARD	3 (+) 12 (-) 	268A (+) 262 (-)	+5 VDC
POWER BOARD CONNECTOR PLUG J43	CHECK +20 VDC STT SUPPLY FROM POWER BOARD	7 (+) 1 (-) 	345 (+) 346 (-)	+20 VDC

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INPUT BOARD TEST PROCEDURE

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will help determine if the Input Board is sending the correct voltages and also if the Input Board is regulating and producing the correct DC voltages.

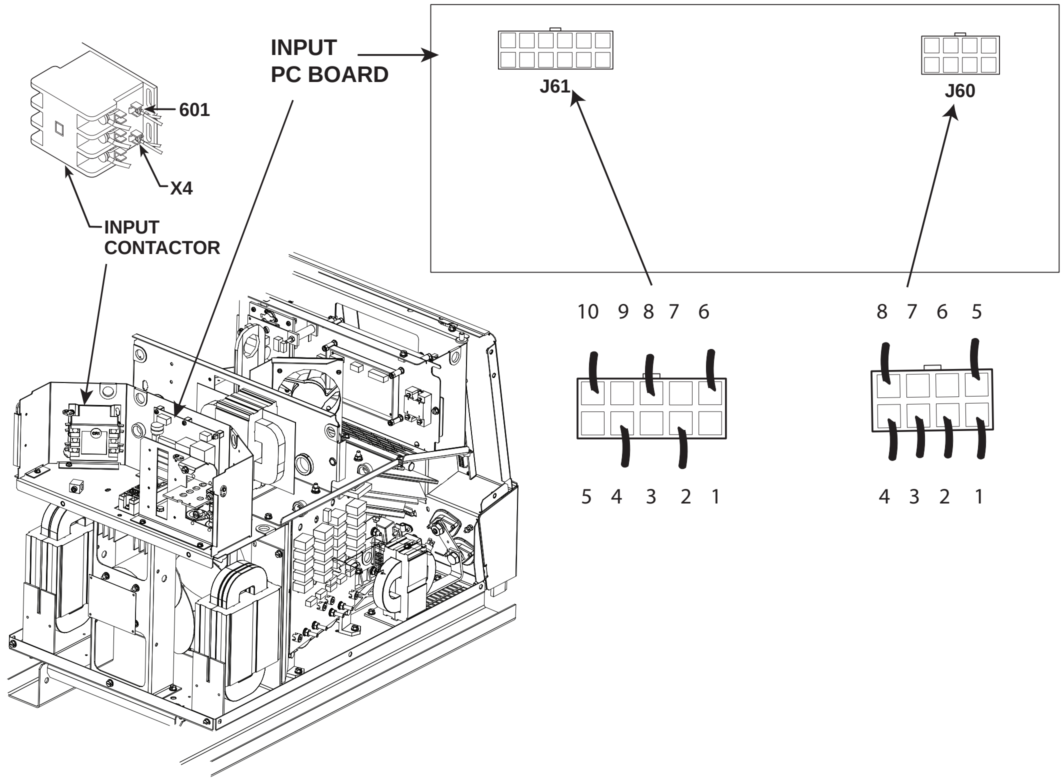
MATERIALS NEEDED

Misc. Hand Tools
Volt-ohmmeter
Wiring Diagram

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Return to Section TOC
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INPUT BOARD TEST PROCEDURE *(CONTINUED)*

FIGURE F.8 – INPUT BOARD AND CONTACTOR



PROCEDURE

1. Disconnect the input power to the POWER WAVE 655/R.
2. Remove the case top.
3. Remove lead X4 from the coil terminal of main input contactor CR1. Insulate lead X4. Refer to Figure F.8.
4. Carefully apply input power to the POWER WAVE 655/R.

WARNING



ELECTRIC SHOCK can kill.

High voltage is present when input power is applied to the machine.

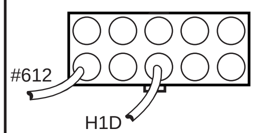
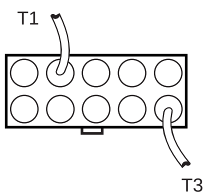
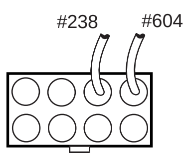
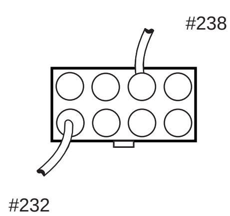
5. Turn on the POWER WAVE 655/R. Carefully test for the correct voltages according to ***Table F.5.***
6. Remove input power to the POWER WAVE 655/R. If any of the voltages are low or not present, perform the ***Input Contactor Test***. If that checks out, the Input Board may by faulty.
7. Reconnect lead X4 to the main input contactor CR1 coil terminal.
8. Carefully apply the correct input voltage to the POWER WAVE 655/R.
9. Turn on the POWER WAVE 655/R. Check for the presence of 24 VAC from lead X4 to lead 601. See ***Figure F. 9***.

   This 24 VAC is the coil voltage for main input contactor CR1. It will normally be present approximately 12 seconds after input line switch (SW1) is activated.
10. If the voltage is not present, perform the ***Auxiliary Transformer #1 Test.***
11. Disconnect the input power and replace the case top.

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INPUT BOARD TEST PROCEDURE *(CONTINUED)*

TABLE F.5 – INPUT BOARD VOLTAGE CHECKS

TEST POINTS	LEAD NUMBERS	EXPECTED VOLTAGE READINGS	COMMENTS
PLUG J61 PIN 8 (H1D) TO PLUG J61 PIN 6 (612)	J61 	SAME AS INPUT VOLTAGE	Present when Input Switch SW1 is closed.
PLUG J61 PIN 10 (T3) TO PLUG J61 PIN 2 (T1)	J61 	A LITTLE LESS THAN INPUT VOLTAGE	This is Pre-Charge Voltage and will normally be present 6 seconds after activating Input Switch SW1. The Pre-Charge Voltage should remain for approximately 6 seconds and then be removed.
PLUG J60 PIN 3 (238) TO PLUG J60 PIN 4 (604)	J60 	13 – 15 VDC	This is the Coil Voltage for the Pre-Charge Relay. Normally this DC Voltage will be present 6 seconds after Input Switch SW1 is activated. This 13 - 15 VDC will remain for approximately 6 seconds and then be removed. The Relay is controlled by the Control Board. See the Wiring Diagram.
PLUG J60 PIN 3 (238) TO PLUG J60 PIN 5 (232)	J60 	13 – 15 VDC	This is the DC Coil Voltage for the Control Relay. Normally this DC Voltage will be present approximately 12 seconds after Input Switch SW1 is activated. The Relay is controlled by the Control PC Board. See the Wiring Diagram.

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CURRENT TRANSDUCER TEST PROCEDURE

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will help determine if the Current Transducer and associated wiring is functioning correctly.

MATERIALS NEEDED

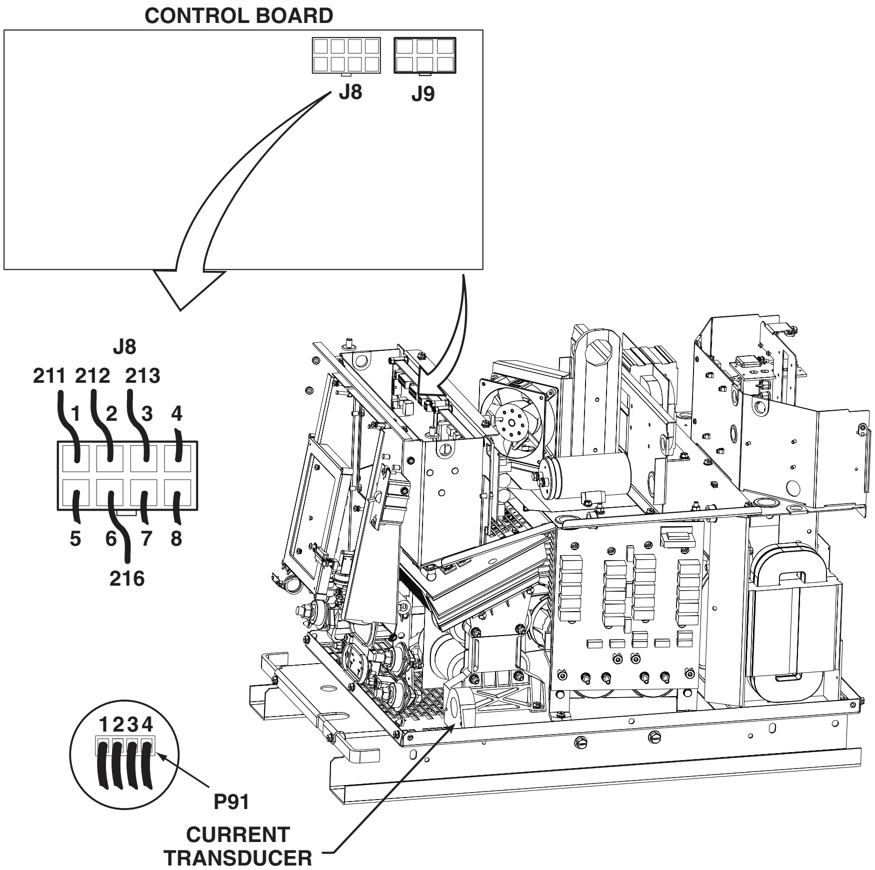
Misc. Hand Tools
Lap-top Computer
Diagnostic Utilities Software
Resistive Load Bank
(Optional - 50 ft., 4/0 weld cable)
Calibrated Ammeter
Volt-Ohmmeter

NOTE: The Diagnostic Utility Software is on the Utilities Disc that was shipped with the machine. It can also be accessed from the Lincoln Service Navigator or downloaded from the “web” at *Powerwavesoftware.com.*

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CURRENT TRANSDUCER TEST PROCEDURE *(CONTINUED)*

FIGURE F.9 – CURRENT TRANSDUCER TEST



PROCEDURE

1. Disconnect the input power to the POWER WAVE 655/R.
2. Remove the case top and the control box cover.
3. Locate the current transducer leads at Control Board plug J8. See Figure F.9.
4. Carefully apply input power to the POWER WAVE 655/R.

⚠ WARNING



ELECTRIC SHOCK can kill.

High voltage is present when input power is applied to the machine.

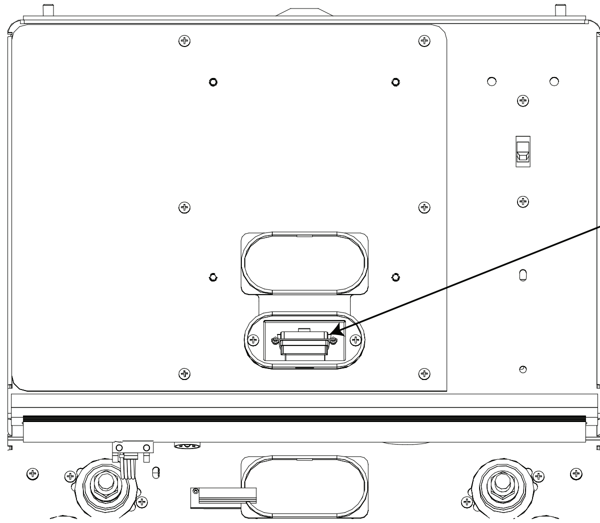
5. Turn on the POWER WAVE 655/R. Check for the correct DC supply voltage to the current transducer at plug J8. See Figure F.9.
   A. Pin 2 (lead 212+) to pin 6 (lead 216-) should read approximately +15 VDC.
   B. Pin 3 (lead 213-) to pin 6 (lead 216+) should read approximately -15 VDC.

NOTE: Do not attempt to check the voltages at the Current Transducer connector. The terminals are small and delicate and may be damaged if probed with meter leads.

If the DC supply voltages are not present, the control board may be faulty. If the supply voltages are correct, procede to Step 6.

CURRENT TRANSDUCER TEST PROCEDURE *(CONTINUED)*

FIGURE F.10 – RS 232 port



6. Connect a laptop computer to the PW655-R via the RS232 port on the front of the machine. See Figure F.10.

7. Connect a Load Bank (or 50' weld cable) to the Positive and Negative Output Studs of the PW655-R.

8. Using the "Diagnostic Utility Software:
   Establish Communication with the PW655R
   Select the 'Calibrate' tab.
   Select the '50 amp' Current Set Point
   Select 'Turn Output ON'
   Use an external calibrated ammeter to read actual current

9. Check the feedback voltage at the Control Board plug J8 per Table F.6.
   Pin 1 (lead 211 +) to pin 6 (lead 216 -).

10. Repeat the test at several other current levels.

    If the feedback voltage is correct for the actual current, the Current Transducer is OK

    If the feeback voltage is not present, check the wiring from the Control Board to the Current Transducer, See the ***Wiring Diagram.***

CAUTION: If using a weld cable across the output studs instead of a Load Bank, do not exceed the current rating of the cable.

11. If supply voltages are correct but feedback voltages are incorrect, the Current Transducer or wiring from P91 to the Control Board may be defective. See the ***Wiring Diagram.***

    If the 'actual' (measured) current does not match the 'set' current but the feedback voltage is correct for the actual current, perform the ***Machine Calibration***.

12. Click on "Turn Output Off"

13. Disconnect the computer.

14. Remove input power and replace the control box cover and case top.

TABLE F.6 - CURRENT FEEDBACK CHART

OUTPUT CURRENT (Actual)	EXPECTED FEEDBACK VOLTAGE
500	4.0
450	3.6
400	3.2
350	2.8
300	2.4
250	2.0
200	1.6
150	1.2
100	0.8
50	0.4

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OUTPUT RECTIFIER TEST PROCEDURE

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

The test will help determine if any of the output rectifiers are shorted.

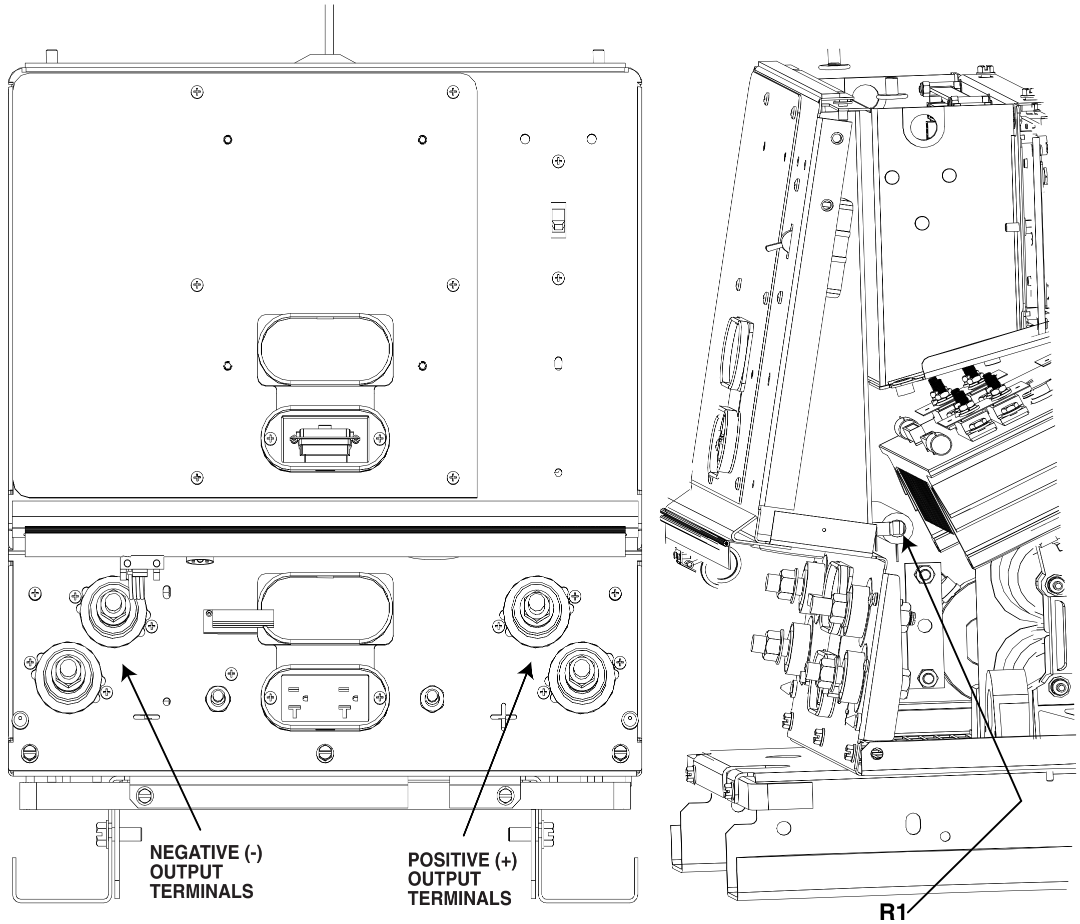
MATERIALS NEEDED

Misc. Hand Tools
Analog Volt-Ohmmeter

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OUTPUT RECTIFIER TEST PROCEDURE *(CONTINUED)*

FIGURE F.11 – OUTPUT RECTIFIER TEST



PROCEDURE

1. Remove main input supply power to the POWER WAVE 655/R.
2. Remove the case sides and perform the ***Input Filter Capacitor Discharge*** procedure.
3. Remove any output cables that may be connected to the POWER WAVE 655/R.
4. Disconnect one end of lead 206A that connects R1 to the Positive Output Terminal.
5. With an ohmmeter, measure the resistance between the positive and negative output terminals. Refer to Figure F.11.

IMPORTANT: The positive (+) meter probe must be attached to the positive (+) output terminal and the negative (-) meter probe must be attached to the negative (-) output terminal.

6. If the reading is more than 200 ohms, the output rectifier modules are not shorted. If the reading is less than 200 ohms, one (or more) of the rectifier modules is shorted. Refer to the ***Output Rectifier Module Replacement*** procedure.
7. Reconnect lead 206A.
8. Replace the case sides.

AUXILIARY TRANSFORMER NO. 1 TEST PROCEDURE

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will determine if the correct voltage is being applied to the primary of Auxiliary Transformer No. 1 and also if the correct voltages are being induced on the secondary windings of the transformer.

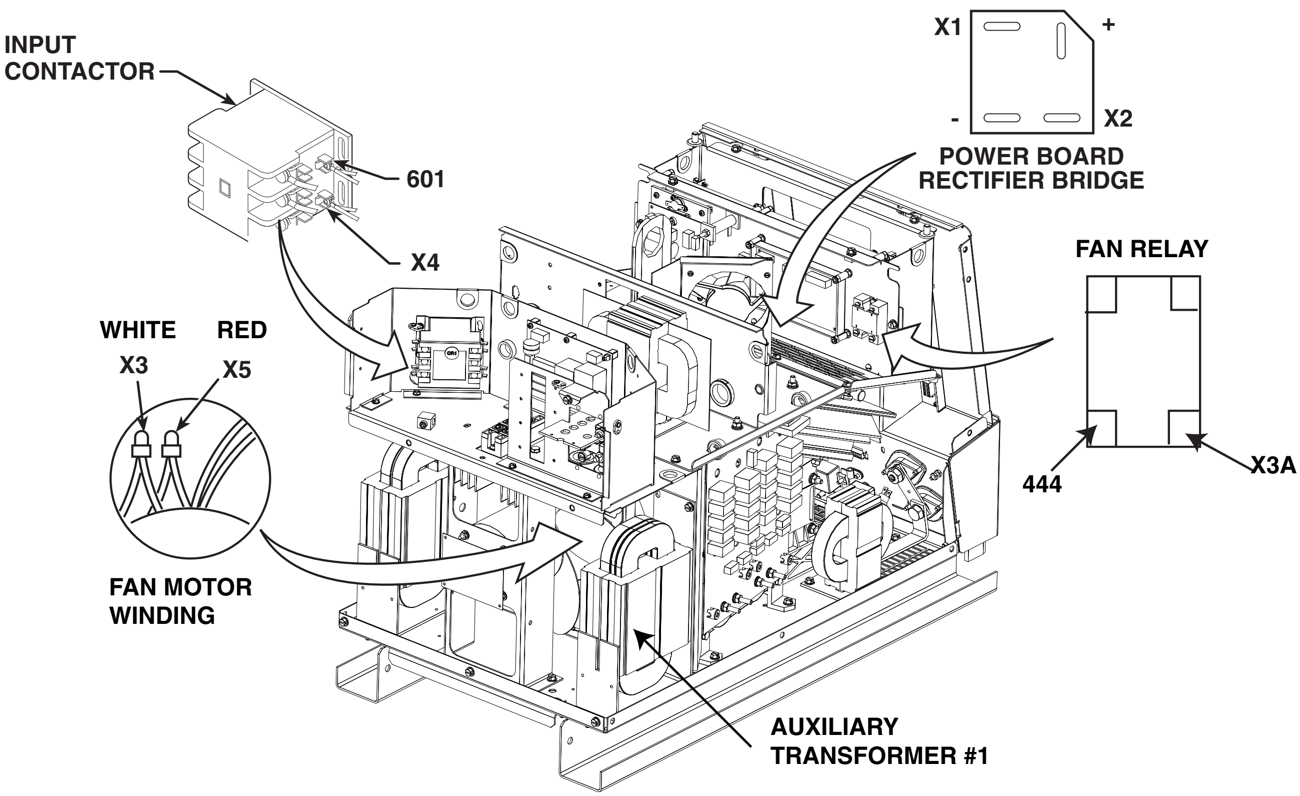
MATERIALS NEEDED

Volt-ohmmeter
Misc. Hand Tools
Wiring Diagram

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AUXILIARY TRANSFORMER NO. 1 TEST PROCEDURE *(CONTINUED)*

FIGURE F.12 – AUXILIARY TRANSFORMER NO. 1 TEST



PROCEDURE

1. Remove the main input power to the POWER WAVE 655/R machine.
2. Remove the case top and sides.
3. Perform the ***Capacitor Discharge*** procedure.
4. Locate secondary leads X1 and X2 (at power board rectifier bridge). Refer to Figure F.12.
5. Locate secondary leads X3 and X5 (fan motor leads).
6. Locate secondary lead X4 (at main contactor).

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AUXILIARY TRANSFORMER NO. 1 TEST PROCEDURE *(CONTINUED)*

7. Carefully apply the correct input voltage to the POWER WAVE 655/R.

⚠ WARNING



ELECTRIC SHOCK can kill.

High voltage is present at primary of the Auxiliary Transformer.

8. Check for the correct secondary voltages according to Table F.7.

NOTE: The secondary voltages will vary proportionally if the input line voltage varies from nominal.

9. If the correct secondary voltages are present, the T1 auxiliary transformer is functioning properly. If any of the secondary voltages are missing or low, check to make certain the primary is configured correctly for the input voltage applied. See the ***Wiring Diagram***.

10. If the correct input voltage is applied to the primary, and the secondary voltage(s) are not correct, the T1 transformer may be faulty.

11. Replace any cables ties and insulation removed earlier.

12. Replace the case sides and top.

TABLE F.7 – SECONDARY VOLTAGES

LEAD IDENTIFICATION	NORMAL EXPECTED VOLTAGE
X1 to X2	52 VAC
X3 to X5	115 VAC
X3 to X4	24 VAC

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AUXILIARY TRANSFORMER NO. 2 TEST PROCEDURE

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will determine if the correct voltage is being applied to the primary of Auxiliary Transformer No. 2 and also if the correct voltages are being induced on the secondary windings of the transformer.

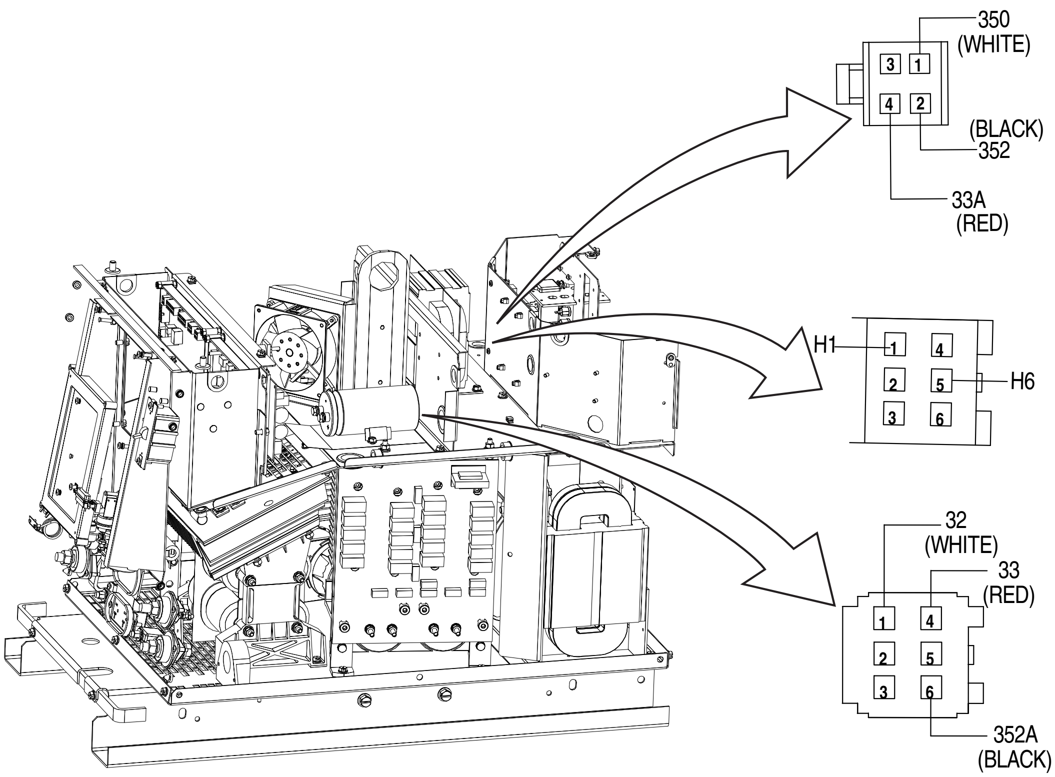
MATERIALS NEEDED

Volt-ohmmeter
Misc. HAnd Tools
Wiring Diagram

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AUXILIARY TRANSFORMER NO. 2 TEST PROCEDURE *(CONTINUED)*

FIGURE F.13 – AUXILIARY TRANSFORMER NO. 2 TEST



PROCEDURE

1. Remove the main input power to the POWER WAVE 655/R machine.
2. Remove any load that may be connected to the 115 VAC receptacle.
3. Remove the case top and right side.
4. Locate plugs P52 and P50 at the Auxiliary Transformer No. 2. Refer to Figure F.13.
5. Carefully apply the correct input power.

⚠ WARNING

ELECTRIC SHOCK can kill.

High voltage is present at both plugs.

6. Check for 115 VAC at plug P52 pins 1 and 4 (leads 350 to 33A). Check for 230 VAC at plug P52 pins 1 and 2 (leads 350 to 352).
7. If 115 VAC and 230 VAC are present, Auxiliary Transformer No. 2 is good.
8. If 115 is not present between pins 1 and 4, and 230 VAC is not present between pins 1 and 2, check the associated leads and plugs for loose or faulty connections.
9. Carefully test for the correct AC input voltage applied to the primary windings at plug P50. See the ***Wiring Diagram***.
10. If the correct AC input voltage is applied to the primary of the Auxiliary Transformer No. 2 and the secondary voltage is not correct, the transformer may be faulty. Replace.
11. Replace any cables ties and insulation removed earlier.
12. Replace the case top and side.

Return to Section TOC
Return to Master TOC

INPUT RECTIFIER REMOVAL AND REPLACEMENT PROCEDURE

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

This procedure will aid the technician in the removal and replacement of the input rectifier module.

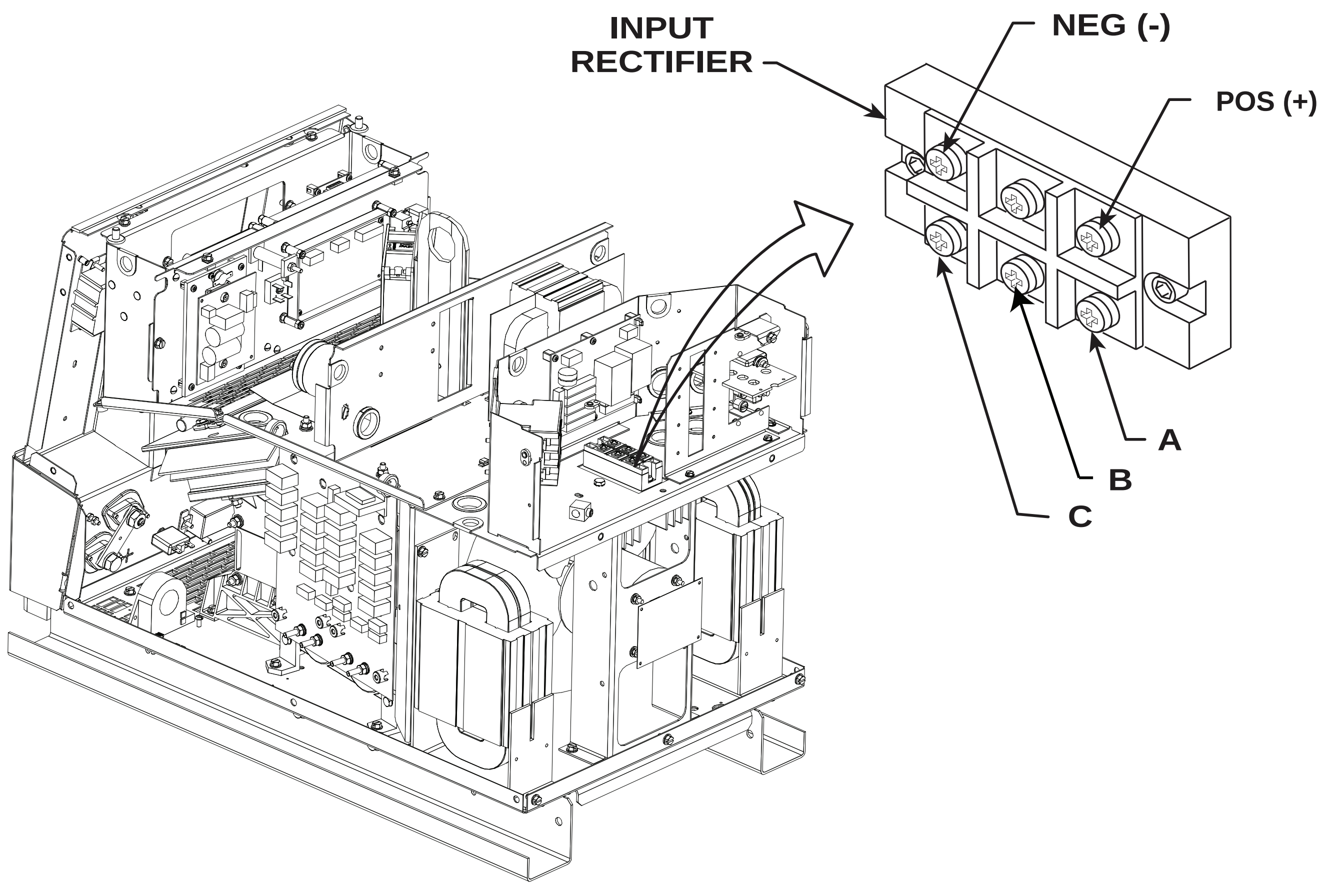
MATERIALS NEEDED

Misc. Hand Tools
Torque Wrench

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INPUT RECTIFIER REMOVAL AND REPLACEMENT PROCEDURE *(CONTINUED)*

FIGURE F.14 – INPUT RECTIFIER REMOVAL AND REPLACEMENT



REMOVAL PROCEDURE

1. Remove input power to the POWER WAVE 655/R.
2. Remove the case top, sides, and input access panel.
3. Perform the ***Capacitor Discharge*** procedure.
4. Remove the RTV sealant from the input rectifier connection terminals. See Figure F. 14.
5. Label and carefully remove the five leads from the input rectifier terminals. Note placement for reassembly. See Figure F.14.
6. Using a 3/16” allen wrench, remove the two mounting screws and washers from the rectifier module.
7. Carefully remove the input rectifier module.

REPLACEMENT PROCEDURE

NOTE: Any instructions that are shipped with the replacement part will supersede these instructions.

1. Clean heat sink surfaces.
2. Apply a thin, even film (.004” t0 .01”) of thermal compound (Penetrox A13) to the module. Keep the compound away from the mounting holes. Compound in the holes or on the threads of the screws will affect the ability to get the proper torque.
3. Mount the module to the heat sink and evenly torque the mounting screws (with washers) to 44 in/lbs.
4. Assemble the leads to the correct module terminals and torque to 31 in/lbs. See Figure F.14.
5. Apply RTV sealant to the rectifier connection terminals.
6. Replace the case top, sides, and input access panel.

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INPUT CONTACTOR REMOVAL AND REPLACEMENT PROCEDURE

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

This procedure will aid the technician in the removal and replacement of the input contactor.

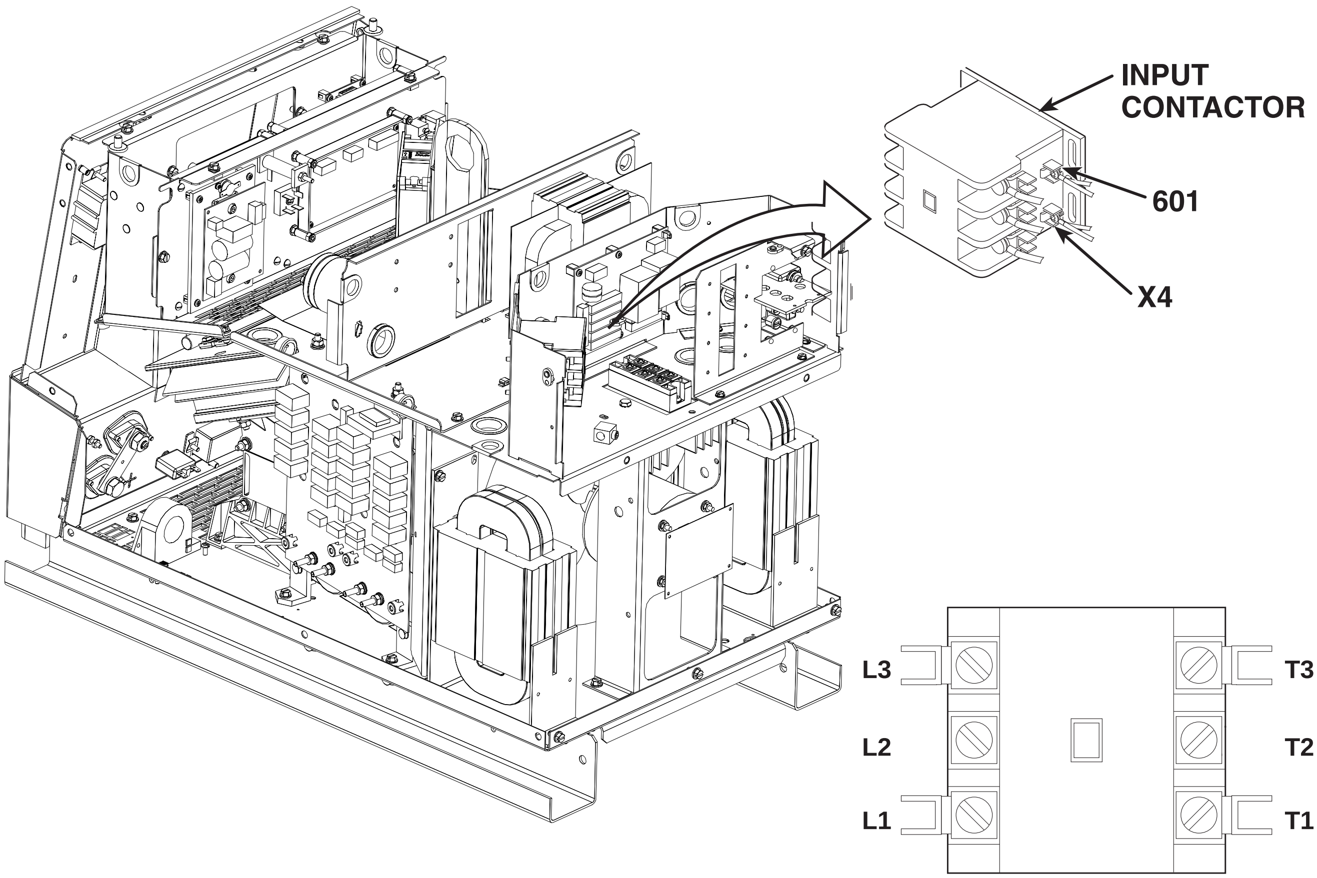
MATERIALS NEEDED

Misc. Hand Tools

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INPUT CONTACTOR REMOVAL AND REPLACEMENT PROCEDURE *(CONTINUED)*

FIGURE F.15 – INPUT CONTACTOR REMOVAL AND REPLACEMENT



REMOVAL PROCEDURE

1. Remove input power to the POWER WAVE 655/R.
2. Remove the case top, sides and input access panel.
3. Perform the ***Capacitor Discharge*** procedure
4. Locate the input contactor. Label and carefully remove the leads from the input contactor terminals. Note placement for reassembly. See Figure F.15.
5. With a 5/16" nut driver or socket, remove the three mounting screws. See Figure F.15.
6. Carefully remove the input contactor.

REPLACEMENT PROCEDURE

1. Mount the contactor and tighten the mounting screws.
2. Connect the leads to the correct terminals. See Figure F.15.
3. Replace the case top, sides and input access panel.

AUXILIARY TRANSFORMER NO. 1 REMOVAL AND REPLACEMENT PROCEDURE

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

This procedure will aid the technician in the removal and replacement of auxiliary transformer No. 1.

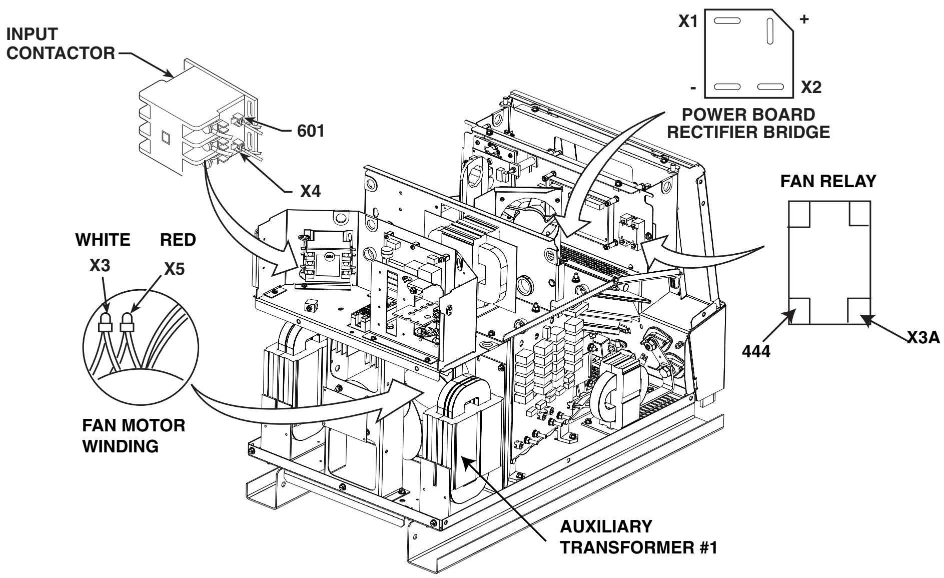
MATERIALS NEEDED

Misc. Hand Tools
Wire splicing or soldering equipment

Return to Section TOC
Return to Master TOC

AUXILIARY TRANSFORMER NO. 1 REMOVAL AND REPLACEMENT PROCEDURE *(CONTINUED)*

FIGURE F.16 – AUXILIARY TRANSFORMER NO. 1 REMOVAL AND REPLACEMENT



REMOVAL PROCEDURE

1. Remove input power to the POWER WAVE 655/R.
2. Remove the case top, sides and input access panel.
3. Perform the ***Capacitor Discharge*** procedure.
4. Remove the case back.
5. Disconnect lead X4 from the input contactor coil.
6. Remove leads X1 and X2 from the power board rectifier bridge. Refer to Figure16.
7. Cut X3 and X5 from the fan motor leads. Leave enough length to splice in the new transformer leads.
8. Cut the X3 lead that is connected to the input board. Leave enough lead length to splice in the new transformer lead.
9. Locate, label, and remove primary lead H1 from circuit breaker CB4.
10. Label and remove primary leads H2, H3, H4, and H5 from the terminals on the reconnect panel. Note lead placement for reassembly.
11. Cut cable ties as necessary and clear the leads.
12. Remove the two mounting screws holding the transformer to the fan baffle and the base.
13. Carefully remove the transformer from the POWER WAVE 655/R.

REPLACEMENT PROCEDURE

1. Carefully place the transformer into the POWER WAVE 655/R.
2. Secure the transformer to the fan baffle and the base.
3. Connect the primary leads H2, H3, H4, and H5 to the proper terminals on the reconnect panel.
4 Connect primary lead H1 to circuit breaker CB4.
5. Splice the X3 lead of the new transformer with the X3 lead connected to the input board.
6. Splice X3 and X5 leads of the new transformer to the fan motor leads X3 and X5.
7. Connect lead X4 to the main contactor coil terminal.
8. Connect leads X1 and X2 to the power board rectifier bridge.
9. Reposition any wire leads and install cable ties as necessary.
10. Replace the case back, sides and top.

AUXILIARY TRANSFORMER NO. 2 REMOVAL AND REPLACEMENT PROCEDURE

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

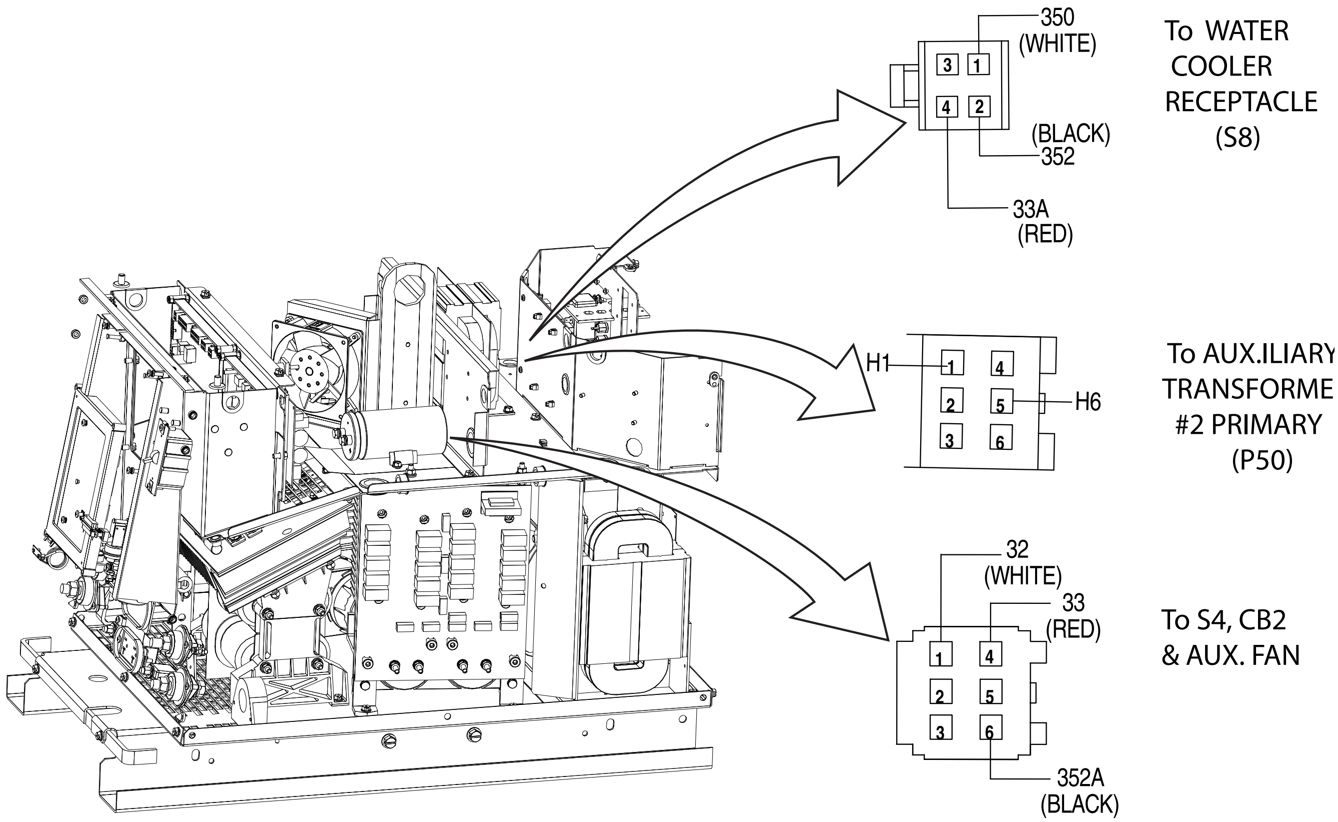
This procedure will aid the technician in the removal and replacement of auxiliary transformer No. 2.

MATERIALS NEEDED

Misc. Hand Tools

AUXILIARY TRANSFORMER NO. 2 REMOVAL AND REPLACEMENT PROCEDURE *(CONTINUED)*

FIGURE F.17 – AUXILIARY TRANSFORMER NO. 2 REMOVAL AND REPLACEMENT



REMOVAL PROCEDURE

1. Remove input power to the POWER WAVE 655/R.
2. Remove the case top, sides and input access panel.
3. Perform the ***Capacitor Discharge*** procedure.
4. Remove the case back.
5. Disconnect the three Molex Connectors indicated in Figure 17.
7. Remove the transformer mounting screws from the Fan Baffle and the base.
8. Carefully remove the transformer from the POWER WAVE 655/R.

REPLACEMENT PROCEDURE

1. Carefully place the transformer into the POWER WAVE 655/R.
2. Install the two mounting screws that hold the transformer to the machine base using the 3/8" nut driver.
3. Connect leads 33 and 32 to circuit breaker CB4 and the 115 V receptacle.
4. Connect plugs P50 and P52.
5. Reposition any leads and install cable ties as necessary.
6. Replace the case back.
7. Replace the case top, sides, and input access panel.

Return to Section TOC
Return to Master TOC

CONTROL, FEED HEAD, VOLTAGE SENSE, OR AUXILIARY DRIVER BOARD REMOVAL AND REPLACEMENT

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

This procedure will aid the technician in the removal and replacement of either the Control Board the Feed Head Board, the Auxiliary Driver Board or the Voltage Sense Board.

MATERIALS NEEDED

Misc. Hand Tools
Anti-static wrist strap

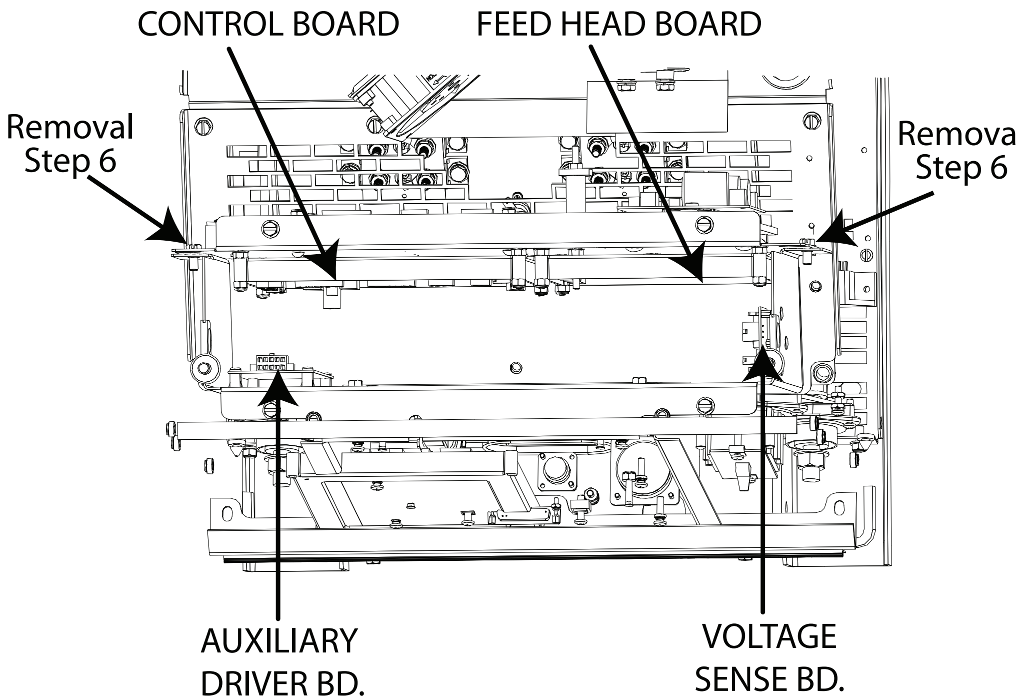
CAUTION **PC Boards can be damaged by static electricity.**

- Remove your body's static charge before opening the static-shielding bag. Wear an anti-static wrist strap. For safety, use a 1 MΩ resistive cord connected to a grounded part of the equipment frame.
- If you don't have a wrist strap, touch an unpainted, grounded, part of the equipment frame. Keep touching the frame to prevent static build-up. Be sure not to touch any electrically live parts at the same time.
- Tools which come in contact with the PC Board must be either conductive, anti-static or static-dissipative.

Return to Section TOC
Return to Master TOC

CONTROL, FEED HEAD, VOLTAGE SENSE OR AUXILIARY DRIVER BOARD REMOVAL AND REPLACEMENT PROCEDURE *(CONTINUED)*

FIGURE F.18 – CONTROL OR FEED HEAD BOARD REMOVAL AND REPLACEMENT



REMOVAL PROCEDURE

1. Remove input power to the POWER WAVE 655/R.
2. Remove the case top and sides.
3. Perform the ***Capacitor Discharge*** procedure.

Observe all static electricity precautions.

4. Remove the PC board compartment cover.
5. Remove the two screws holding the rear of the Control Box in place. See Figure 18.
6. Clear the leads in the sleeving and the grommets on the sides of the control box.
7. Label and remove the molex plugs from the Control Board and the Feed Head Board.
8. Tilt back the rear of the control box to access the PC board mountings.
9. To remove the Voltage Sense Board, use a needle-nose pliers to carefully pinch the three plastic standoffs to release the board.
10. Use a Phillips screwdriver to remove the Auxiliary Driver Bd.

REPLACEMENT PROCEDURE

1. Install the replacement board using the original fasteners
2. Connect the Molex plugs to the Control Board and the Feed Head Board. Be sure the lead harnesses are securely and properly positioned.
3. Use a Phillips screwdriver to replace the Auxiliary Driver Board.
4. Press the Voltage Sense Board onto its standoffs. Make sure the board snaps into place on all three standoffs.
5. Secure the rear of the control box in place using two screws. Be careful not to pinch any wires between the control box sheeet metal pieces.
6. Replace any cable ties that might have been removed.
7. Replace the PC board compartment cover.
8. Replace the case top and sides.

NOTE: If the Control Board is replaced it will be necessary to do the ***Calibration Procedure.***

Return to Section TOC
Return to Master TOC

ETHERNET/GATEWAY PC BOARD REMOVAL AND REPLACEMENT PROCEDURE

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

This procedure will aid the technician in the removal and replacement of the Gateway PC Board.

MATERIALS NEEDED

Misc, Hand Tools
Anti-static wrist strap

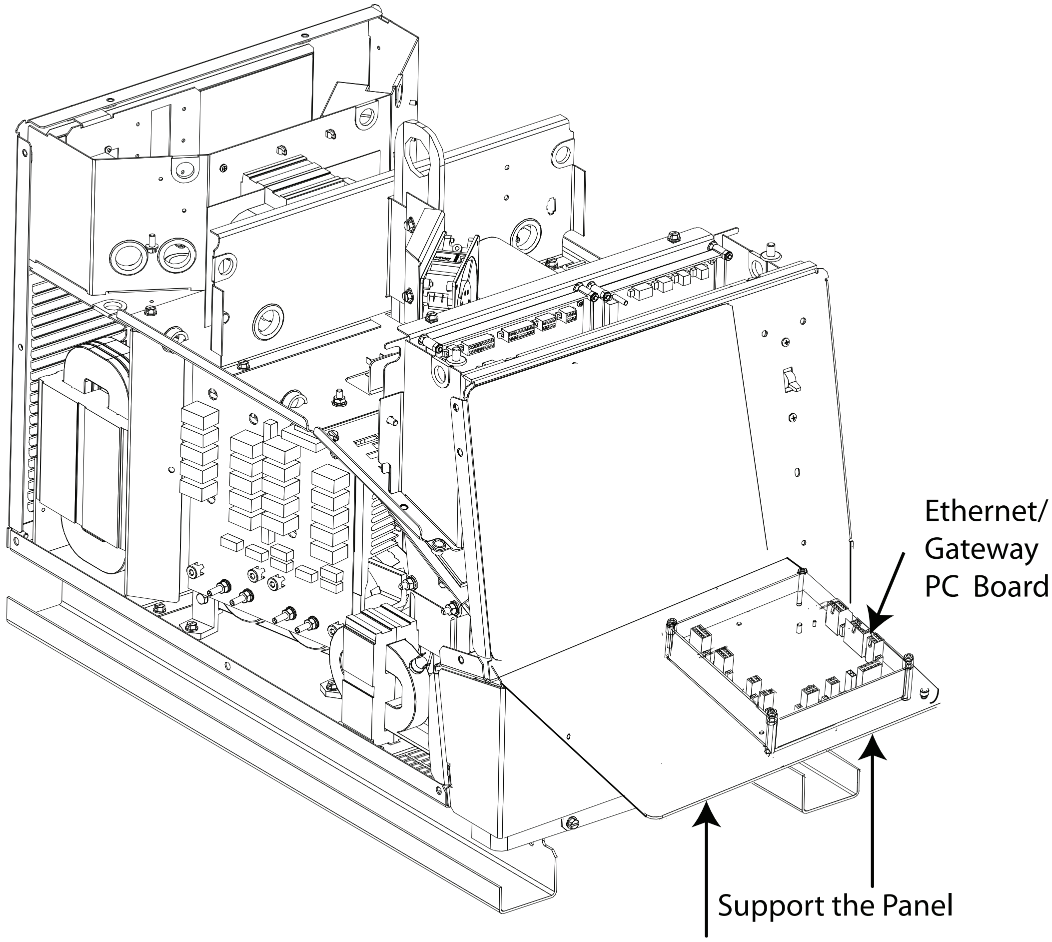
CAUTION: PC Boards can be damaged by static electricity.

- Remove your body's static charge before opening the static-shielding bag. Wear an anti-static wrist strap. For safety, use a 1 MΩ resistive cord connected to a grounded part of the equipment frame.
- If you don't have a wrist strap, touch an unpainted, grounded, part of the equipment frame. Keep touching the frame to prevent static build-up. Be sure not to touch any electrically live parts at the same time.
- Tools which come in contact with the PC Board must be either conductive, anti-static or static-dissipative.

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Return to Section TOC
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ETHERNET/GATEWAY PC BOARD REMOVAL AND REPLACEMENT PROCEDURE *(CONTINUED)*

FIGURE F.19 – GATEWAY BOARD REMOVAL AND REPLACEMENT



REMOVAL PROCEDURE

1. Remove input power to the POWER WAVE 655/R.
2. Using a phillips head screw driver, remove the six screws from the case front cover. Tilt the cover down and support it from below to avoid stressing the electrical connections. See Figure F.19.

Observe all static electricity precautions.

3. Disconnect the four molex plugs and the network cable from the Ethernet/Gateway Board.
4. Remove the self-locking mounting nuts and carefully remove the board. Refer to Figure F.19.

REPLACEMENT PROCEDURE

1. Install the new Ethernet/Gateway Board to the case front cover with the self-locking nuts.
2. Reconnect the molex plugs and the network cable.
3. Re-attach the cover to the case front, being careful not to stress or pinch the wires.

CURRENT TRANSDUCER
REMOVAL AND REPLACEMENT PROCEDURE

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

This procedure will aid the technician in the removal and replacement of the Current Transducer.

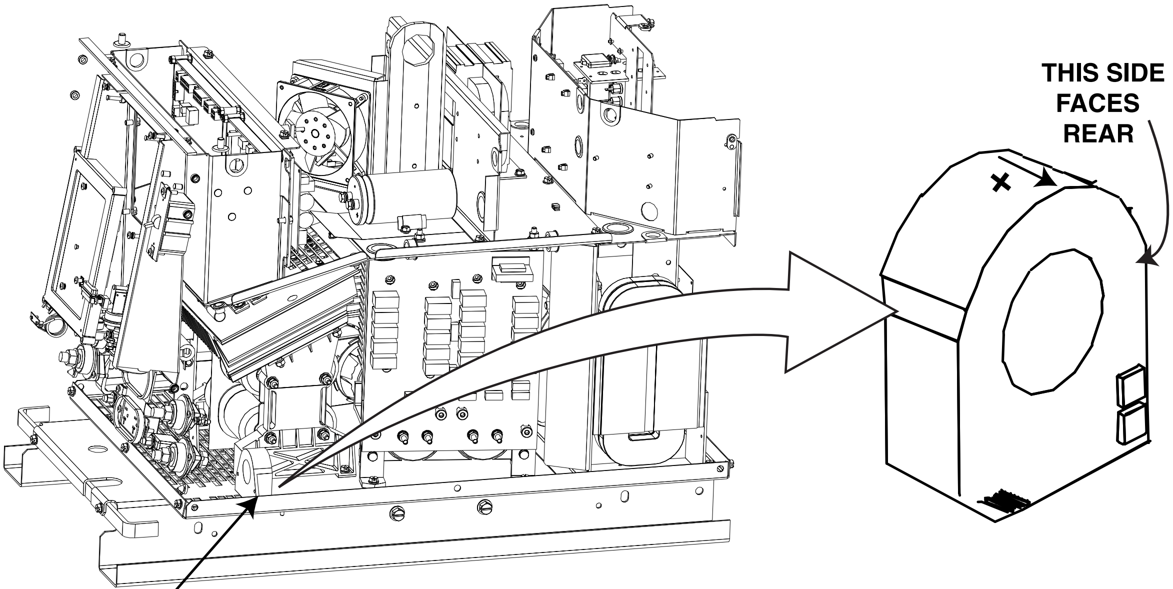
MATERIALS NEEDED

Misc. Hand Tools
Wiring Diagram

Return to Section TOC
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CURRENT TRANSDUCER
REMOVAL AND REPLACEMENT PROCEDURE *(CONTINUED)*

FIGURE F.20 – POWER WAVE CURRENT TRANSDUCER REMOVAL AND REPLACEMENT PROCEDURE



REMOVAL PROCEDURE

1. Remove input power to the POWER WAVE 655/R.
2. Remove the case sides.
3. Perform the ***Capacitor Discharge procedure***.
4. Remove the 1/2” bolt that holds the 4/0 cable to the back of the lower right (+) Output Stud.
5. Cut the tie wrap that holds the harness to the transducer and disconnect P91.
6. Using a phillips head screw driver, remove the screws and lock washers that hold the transducer to the machine base.
7. Side the current transducer off of the 4/0 cable, noting the direction of the current flow indicator (arrow).

REPLACEMENT PROCEDURE

1. Slide the new Transducer over the 4/0 cable. Be certain that the current flow indictor (arrow) points towards the back of the machine. See Figure F.20.
2. Mount the Transducer to the machine base with the two Phillips head screws.
3. Re-connect the 4/0 cable to the Output Stud.
4. Carefully re-connect the 4 pin connector (P-91) to the Transducer and secure the harness with a tie wrap.
5. Replace the case sides.

OUTPUT RECTIFIER MODULE REMOVAL AND REPLACEMENT PROCEDURE

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

This procedure will aid the technician in the removal and replacement of the output rectifier modules.

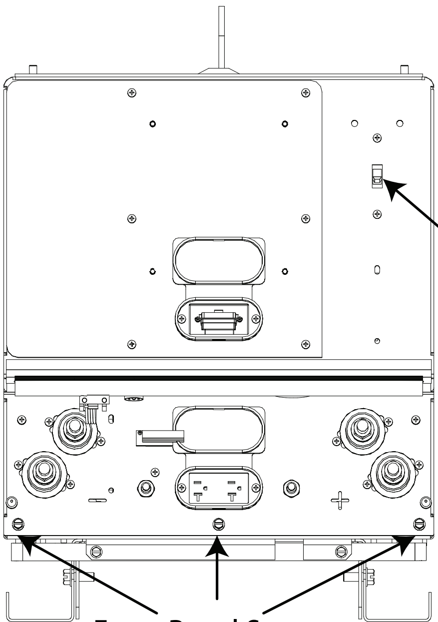
MATERIALS NEEDED

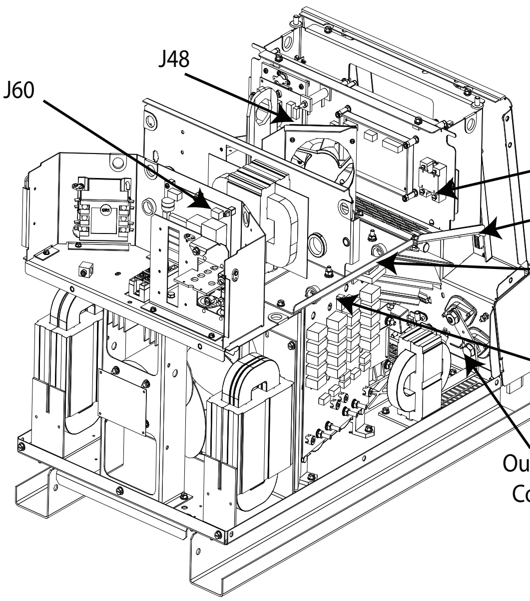
Misc. Hand tools
Penetrox A13 Thermal Joint Compound
Wiring Diagram

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Return to Master TOC
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OUTPUT RECTIFIER MODULE REPLACEMENT PROCEDURE *(CONTINUED)*

FIGURE F.21 – ACCESSING THE RECTIFIER MODULE





ACCESSING THE RECTIFIER MODULE

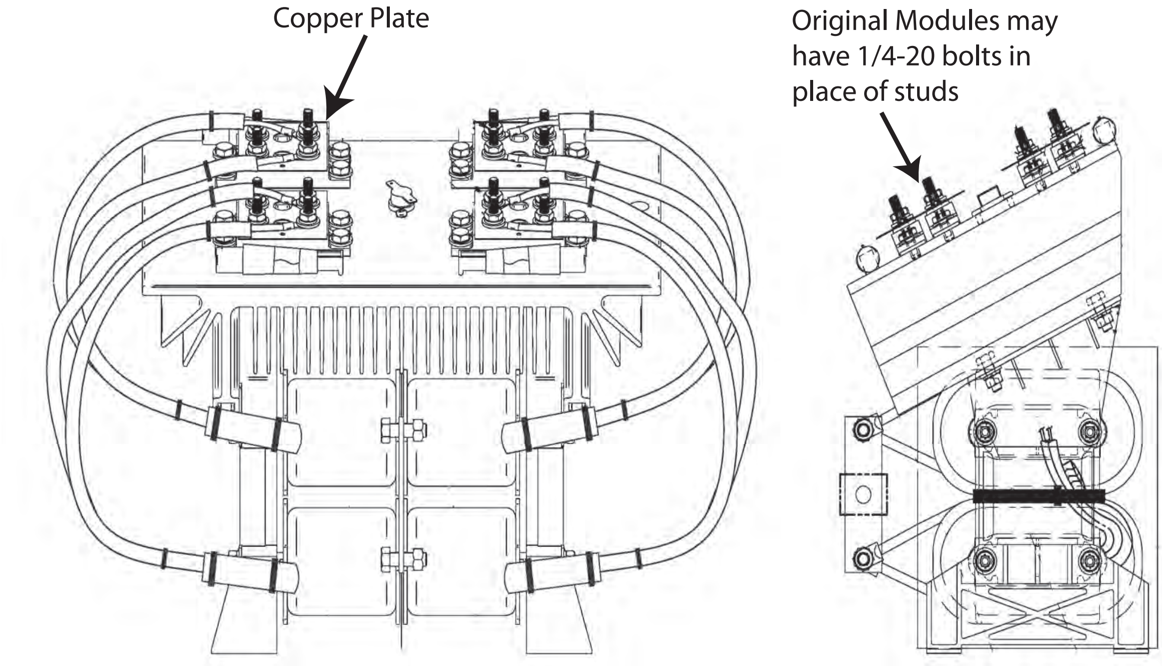
1. Remove input power to the POWER WAVE 655/R.
2. Remove the case top and sides.
3. Perform the ***Capacitor Discharge*** procedure.
4. Disconnect the J60 Molex connector from the Input Board. (See Fig. F.21).
5. Disconnect J40 and J50 Molex connectors from the Switch Boards. (See Fig.F.21).
6. Cut wire ties as necessary and pull the J40, J50 & J60 harnesses and grommets through the panels.
7. Disconnect the output leads (444 & X3A) from the bottom terminals of the Fan Relay.
8. Disconnect the J48 Molex connector from the DC Bus Board (lower connector - 4 pin).
9. Remove the two phillips head screws that hold the Power Switch to the front panel. Cut the wire ties as necessary and pull the switch out to the right side of the machine.
10. Remove the 1/2" bolt that holds the Output choke to the Negative Output Stud.
11. Loosen (do not remove) the three screws at the bottom of the front panel.
12. Remove the four screws tha hold the Front Horizontal Divider panel to the Rear Horizontal panel.
13. Tilt the front panel forward far enough to expose all four pairs of diode modules.

    CAUTION: Be careful not to stress or damage the Current Transformer leads that are routed past the right side of the rectifier assembly.

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OUTPUT RECTIFIER AND RECTIFIER MODULE REMOVAL AND REPLACEMENT PROCEDURE *(CONTINUED)*

FIGURE F.22 – RECTIFIER MODULE REPLACEMENT



RECTIFIER MODULE TESTING

1. Remove the leads and copper plate from one of the Diode Module pairs. (See Figure F.22).

NOTE: Observe the placement and the mounting sequence of the leads and hardware so they can be put back in exactly the same way. **The assemblies may be different, depending on the age of the machine.**

2. Using an ohmmeter check the 4 diodes (2 per module) for shorts.

   If a shorted device is detected, recheck at the output studs as directed in the ***Output Rectifier test.*** If the short is cleared there are no more defective modules. If there is still a short, or if none of the disconnected devices is shorted, repeat steps 1 and 2 for the other module pairs untill all defective devices are located.

3. Replace any defective module and the other module of the same pair, even if only one module is defective.

NOTE: Any instructions packaged with the replacement modules will supersede the following instructions.

RECTIFIER MODULE REPLACEMENT

1. Remove the cap screw from the center and the two hex-head bolts that mount the module to the heat sink, and remove the module.
2. Apply a thin, even film (.004” t0 .01”) of thermal compound (Penetrox A13) to the module. Keep the compound away from the mounting holes. Compound in the holes or on the threads of the screws will affect the ability to get the proper torque.
3. Press module against the heat sink, aligning it with the mounting holes and start all three screws by hand.
4. Tighten the two outer screws to between 5 and 10 in.-lbs
5. Tighten the center screw to between 12 and 18 in.-lbs.
6. Tighten the outer screws again, to between 30 and 40 in.-lbs.
7. Re-install the copper plate, snubber lead (or M.O.V. lead) and transformer leads as they were originally and tighten to between 30 and 40 in.-lbs.
8. Re-assemble the machine by performing steps 2 through 13 of ***Accessing the Rectifier Module*** procedure in reverse order.

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Return to Section TOC Return to Master TOC
Return to Section TOC Return to Master TOC
Return to Section TOC Return to Master TOC
Return to Section TOC Return to Master TOC

SWITCH BOARD AND FILTER CAPACITOR REMOVAL AND REPLACEMENT PROCEDURE

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

This procedure will aid the technician in the removal and replacement of the switch board(s) and/or filter capacitor(s).

MATERIALS NEEDED

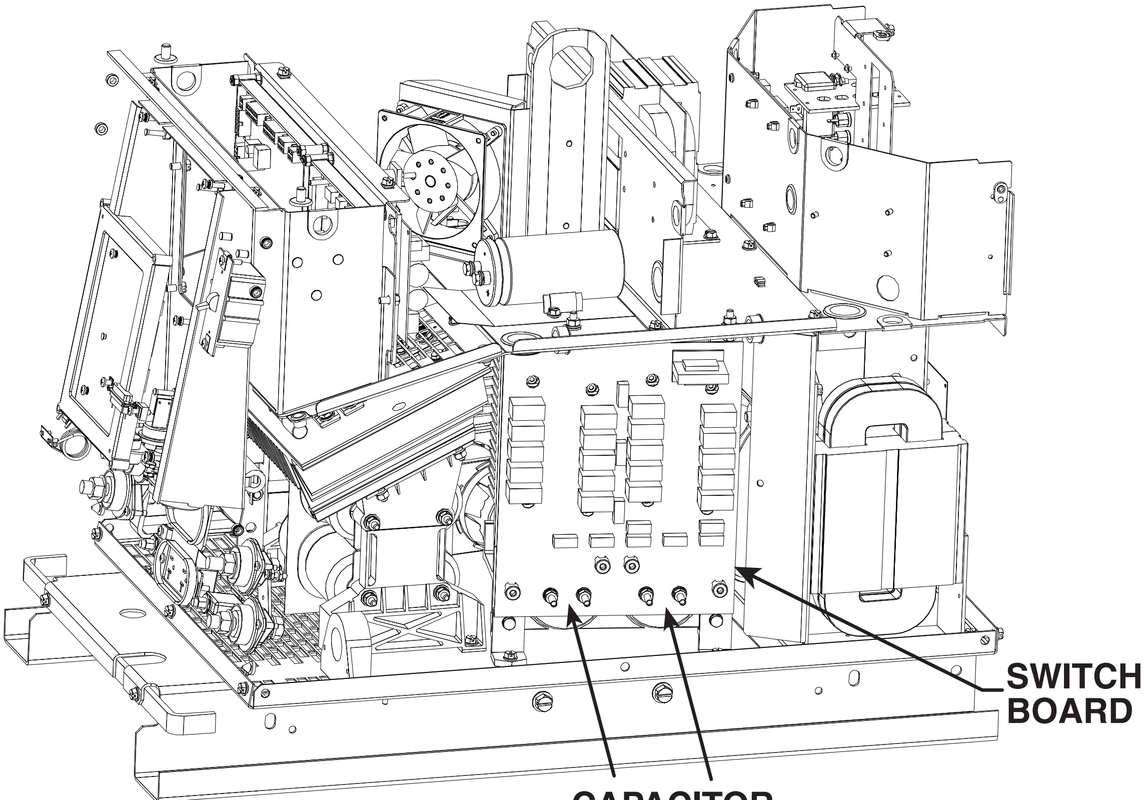
Misc. Hand Tools
Penetrox A13 thermal joint compound

CAUTION: PC Boards can be damaged by static electricity.

- Remove your body's static charge before opening the static-shielding bag. Wear an anti-static wrist strap. For safety, use a 1 Meg ohm resistive cord connected to a grounded part of the equipment frame.
- If you don't have a wrist strap, touch an unpainted, grounded, part of the equipment frame. Keep touching the frame to prevent static build-up. Be sure not to touch any electrically live parts at the same time.
- Tools which come in contact with the PC Board must be either conductive, anti-static or static-dissipative

SWITCH BOARD AND FILTER CAPACITOR REMOVAL AND REPLACEMENT PROCEDURE *(CONTINUED)*

FIGURE F.23 – SWITCH BOARD AND FILTER CAPACITOR REMOVAL AND REPLACEMENT



REMOVAL PROCEDURE

Observe all static electricity precautions.

Lead and plug references below use a slash (/) to indicate machine right side/left side wire number differences.

1. Remove input power to the POWER WAVE 655/R.
2. Remove the case top and sides.
3. Perform the ***Capacitor Discharge*** procedure.
4. Remove the high voltage protective shield.
5. Remove molex plug J40/J50 from the top of the switch board. Refer to Figure F.22.
6. Remove the mylar insulating shield covering leads 13/14 or 17/18. Cut the cable tie.
7. Remove leads 13/14 or 17/18 from the Switch Board.
8. Remove leads 11/12 or 15/16 from the Switch Board.
9. Remove leads 19C/D(+) and 20C/D(-) from the switch board capacitor connection bolts.
10. With a slot head screwdriver, remove the two nylon mounting screws at the bottom of the switch board. Note placement of the shake-proof washers and fiber spacers.
11. Using a 3/16” allen wrench, carefully remove the four cap screws that mount the switch board to the heat sink.
12. Carefully remove the switch board from the heat sink.
13. If the filter capacitors are to be removed, carefully slide them out of the mounting bracket.

SWITCH BOARD AND FILTER CAPACITOR REMOVAL AND REPLACEMENT PROCEDURE *(CONTINUED)*

REPLACEMENT PROCEDURE

NOTE: Any instructions that are shipped with the replacement part will supersede these instructions.

1. If the filter capacitors are to be replaced, carefully slide the new capacitors into the mounting bracket. Position the capacitors so the correct polarity terminal is lined up with the correct hole on the switch board.
2. All heat sink and IGBT mounting surfaces must be clean.
3. Apply a thin, even film (.004" t0 .01") of thermal compound (Penetrox A13) to the module. Keep the compound away from the mounting holes. Compound in the holes or on the threads of the screws will affect the ability to get the proper torque.
4. Apply a thin coat of Penetrox A13 to the capacitor terminals. Be careful not to apply compound to screw threads or threaded area of terminals.
5. Mount the new Switch Board and tighten the four cap head screws in the following manner.

   Tighten all until snug.

   Tighten all from 24 to 28 in-lbs.

   Tighten all from 40 to 48 in-lbs.
6. Make sure the capacitor is positioned correctly. Connect leads 19C/D+ and 20C/D- to the correct terminals. Tighten to 55 in/lbs.
7. Position and mount the two nylon screws, fiber spacers, and washers. Torque from 4 to 8 in-lbs.
8. Connect leads 11/12 or 15/16 to the correct terminal.
9. Connect leads 13/14 or 17/18 to the correct terminal.
10. Install the mylar insulating shield covering leads 11/12 or 15/16. Replace the cable tie.
11. Connect molex plug J40/J50 to the top of the switch board.
12. Replace the high voltage protective shield.
13. Replace the case top and sides.

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CALIBRATION PROCEDURE

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

This procedure will aid the technician in checking and, if necessary, adjusting the calibration of the Power Wave 655R.

Calibration should be checked as part of the ***Test After Repair*** and/or if the Control Board is replaced.

MATERIALS NEEDED

Diagnostic Utilities Software
Laptop or other Suitable Computer
RS-232 Serial Modem Cable or Ethernet Cable
Resistive Load Bank
Two (2) Welding Cables - 20ft. -4/0
Calibrated Ammeter and Voltmeter *

* Calibration inaccuracies due to external metering can and will effect weld performance. Use good quality digital meters that are **calibrated and traceable to National Standards.**

Return to Section TOC
Return to Master TOC

CALIBRATION PROCEDURE *(CONTINUED)*

CALIBRATION SET-UP:

1. Load the Diagnostic Utility Software into the computer.

2. Use the Serial Modem or Ethernet cable to connect the computer to the PW655-R.

   NOTE: If the PW655-R is connected to an Ethernet network, you may use an ethernet cable to connect to the machine instead of the Serial Modem Cable.

3. Connect a resistive load bank to the output studs.

4. Energize the PW655-R.

5. Launch the Diagnostic Utility and establish communication with the PW655-R. (Refer to the Software Documentation to determine proper connection)

6. Click on the "Calibration" tab. A screen similar to Figure F.24 should appear and you are ready to begin the Calibration check

NOTE: The Calibration Screen may look slightly different depending on the software version.

Calibration Tab

⚠ WARNING

Machine output can be turned "on" with this screen.

Feedback Information

- Output Current – Value of Current Sensor Device (transducer).
- Output Voltage – Value of Voltage Sensing point.
- Capacitor Group A and B Voltage values
- Voltage Sense Location – should be sensing at studs for calibration (use "Cable Test" tab to change.)

Current Set Point:

350A machine choose 300A
450A machine choose 300A
650A machine choose 300A
1000A machine choose 500A

Current Weld Mode

- Will always be mode 200 (c.c.) activated from "Turn Output On" button

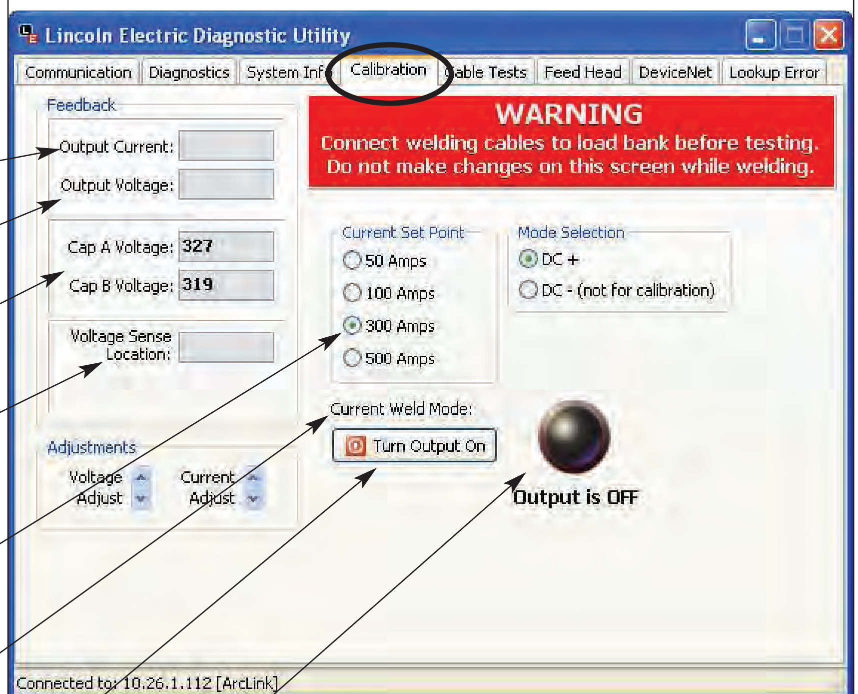
Turn Output ON

- Enables output for calibration
- Light will flash Red when output is "ON"

CALIBRATION ADJUSTMENT ▲ ▼

- System will automaticaly adjust output levels as changes are made

FIGURE F.24 – CALIBRATION SCREEN



Light is <u>BLACK</u> when OFF.

Return to Section TOC
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CALIBRATION PROCEDURE *(CONTINUED)*

**Calibration can only be done under 'static load' conditions.
Do not attempt to calibrate while welding.**

NOTE: Incorrect calibration can and will affect welding performance. It is strongly recommended to use the "Diagnostics" screen to run and save a "Snapshot" before making any calibration adjustments. This will allow returning to original settings if necessary. (Refer to the Software Documentation for instructions on using the Snapshot feature).

CALIBRATION PROCEDURE

1. Once in the "Calibration" screen, make sure that the machine output is OFF (light is BLACK) and connect a resistive load bank to the output studs.

2. Set the load bank for 300 amps.

3. On the Calibration screen, select the "300 Amps" Current Set Point.

NOTE: If the meters on the load bank are not certified, connect calibrated and traceable meters to the machine output. (See ***Materials Needed*** at the beginning of this section).

⚠ WARNING

The Output Studs of the Machine will be HOT during Steps 4 through 7

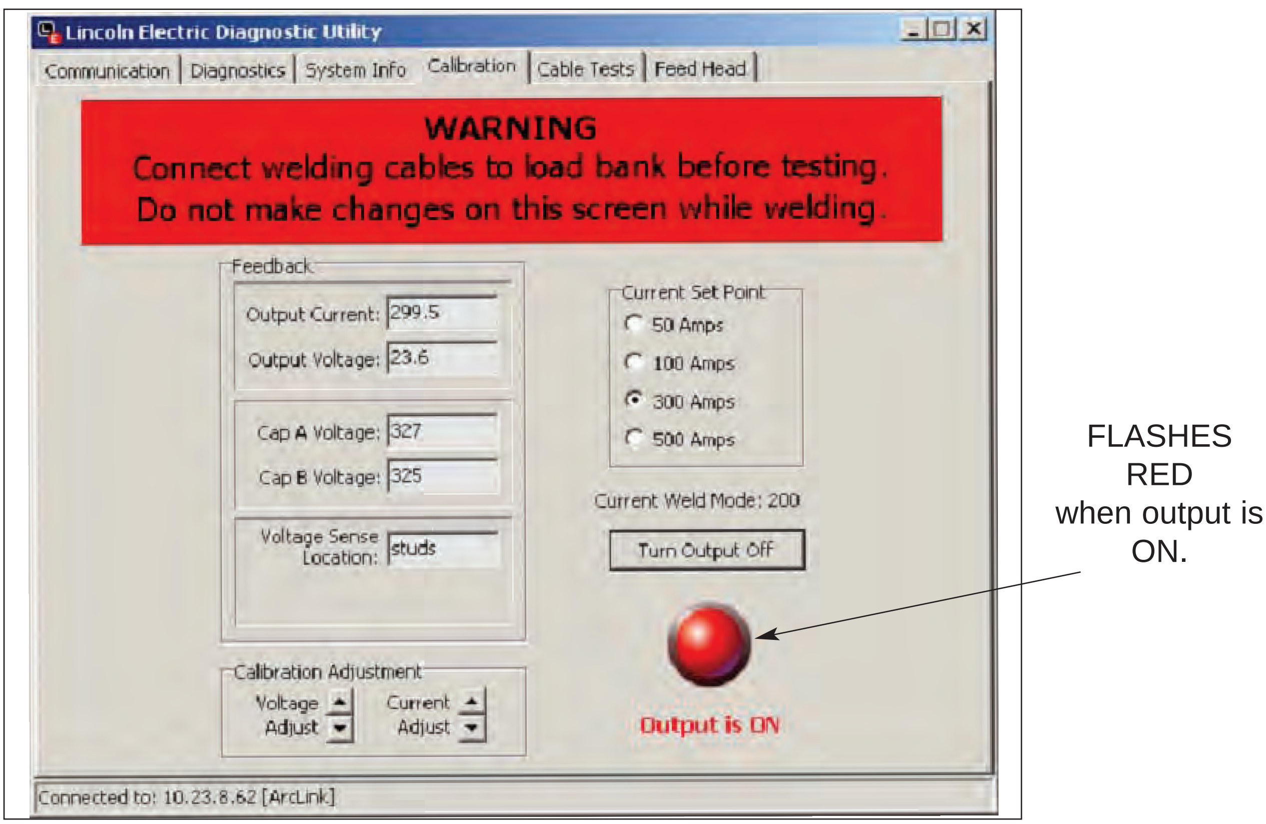
4. Click on the "Turn Output ON" button.
   The BLACK light on the screen will flash RED indicating that the weld output is turned ON. (See Figure F.25).

5. Adjust the load bank to 300 Amps at approximately 32 Volts as read on the external calibrated meters.

6. Using the "Calibration Adjustment" buttons:
   Adjust the current so that the external ammeter reads 300Amps +/-2A.
   Adjust the voltage so that the "Output Voltage" display window reads the same as the external voltmeter +/-.25volts.

7. Click on the "Turn Output Off" button. Calibration is complete.

FIGURE F.25 - CALIBRATION SCREEN



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Return to Master TOC

RETEST AFTER REPAIR

MATERIALS NEEDED

Diagnostic Utilities Software
Laptop or other Suitable Computer
RS-232 Serial Modem Cable or Ethernet Cable
Resistive Load Bank
Two (2) Welding Cables - 20ft. -4/0
Calibrated Ammeter and Voltmeter

TEST PROCEDURE

1. Be certain that the machine is properly connected for the input voltage being applied.
2. Turn the Power Switch ON and see that it goes through the Start-up routine and the Status Light is steady Green.
3. Turn the Power Switch OFF, connect a resistive load across the Output Studs and a computer to the RS-232 port. Perform the ***Calibration Procedure*** to be sure that the machine will produce proper weld output.

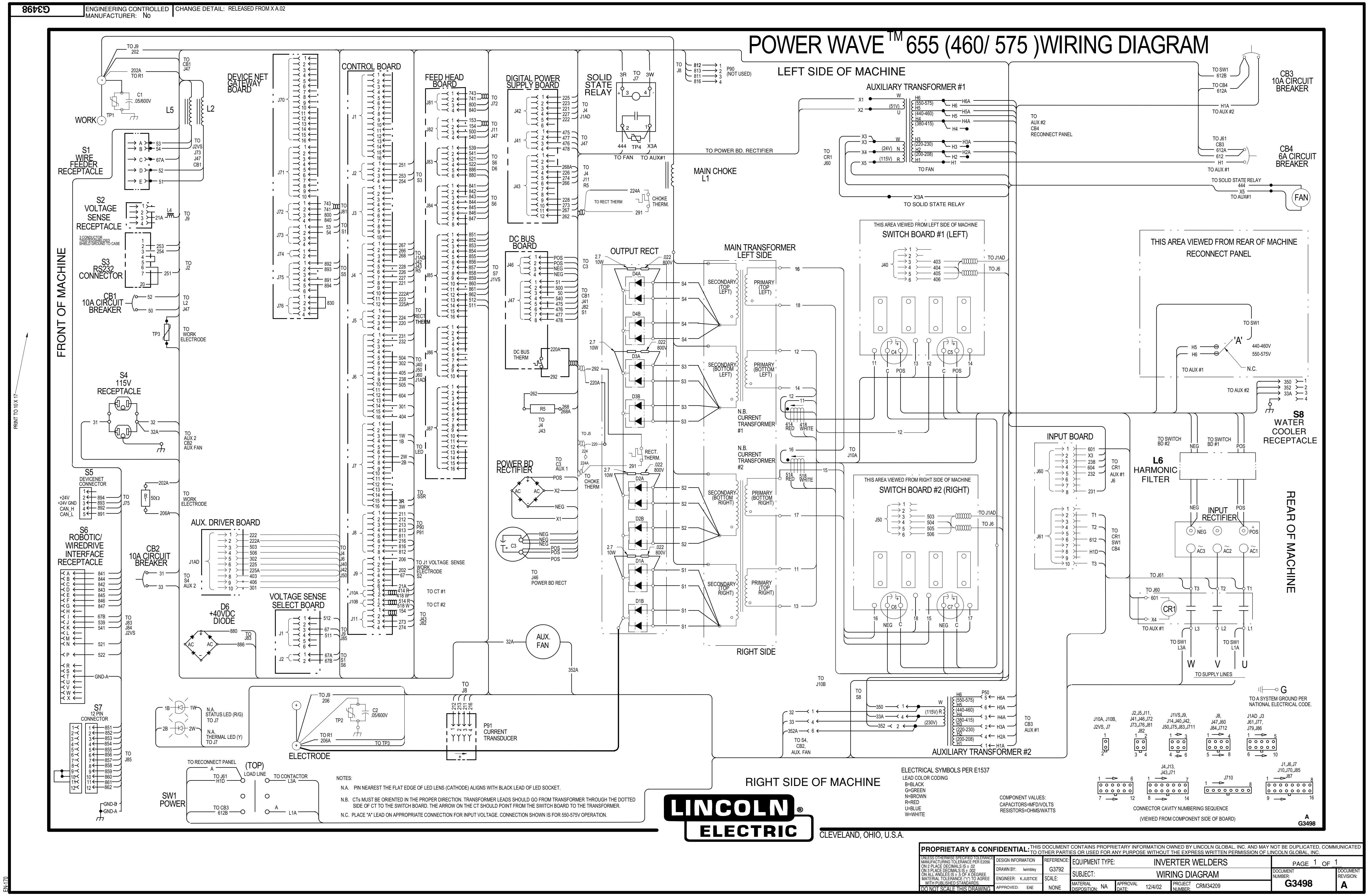
NOTE: Welding and/or wire feed problems may still exist, but may only be evident after the machine is reconnected into the weld cell.

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NOTE: Many PC Board Assemblies are now totally encapsulated, surface mounted and or multi-layered and are therefore considered to be unserviceable. Assembly drawings of these boards are no longer provided.

WIRING DIAGRAM - CODE 10630

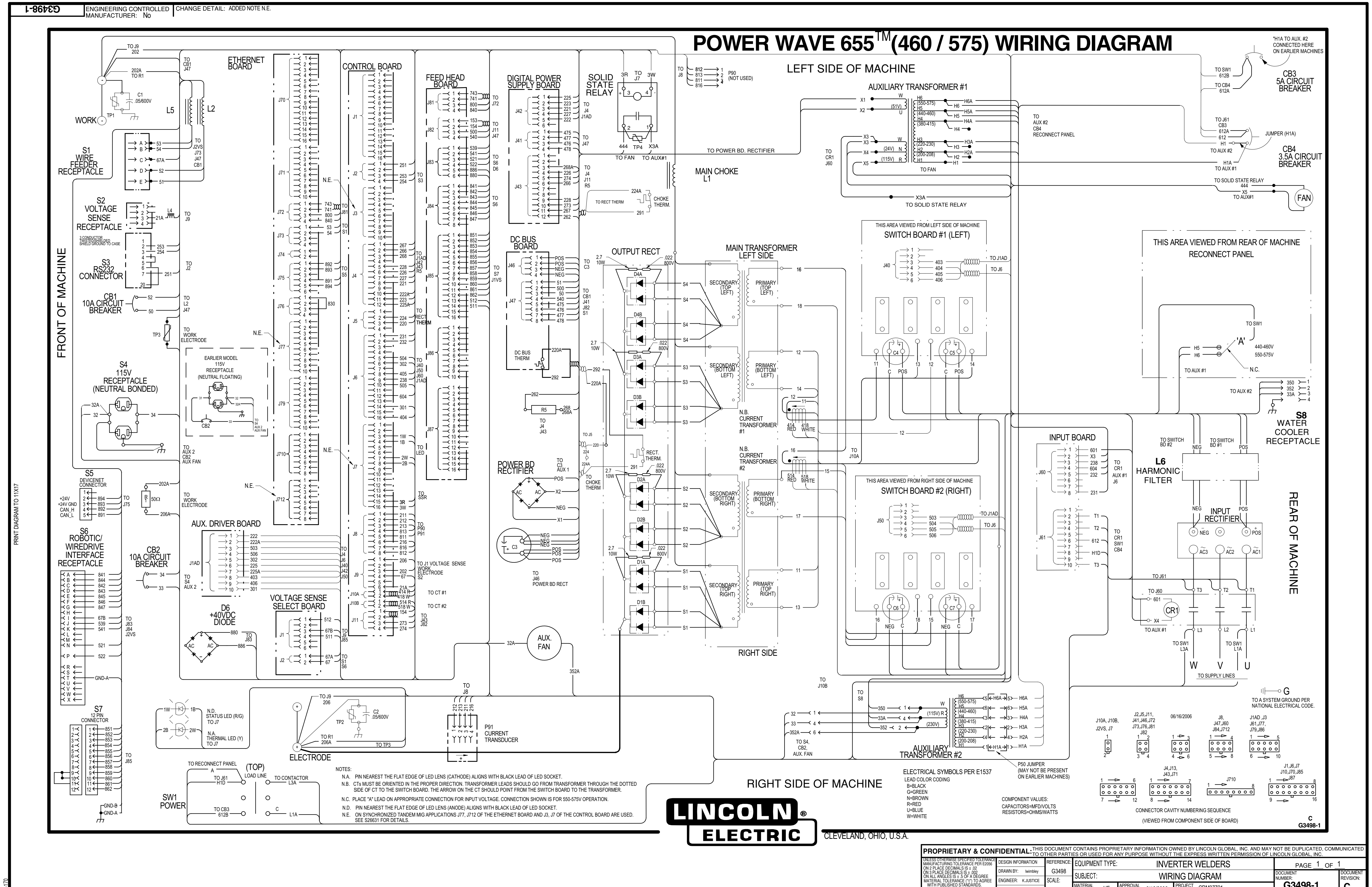


NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual. The wiring diagram specific to your code is pasted inside one of the enclosure panels of your machine.

Return to Section TOC
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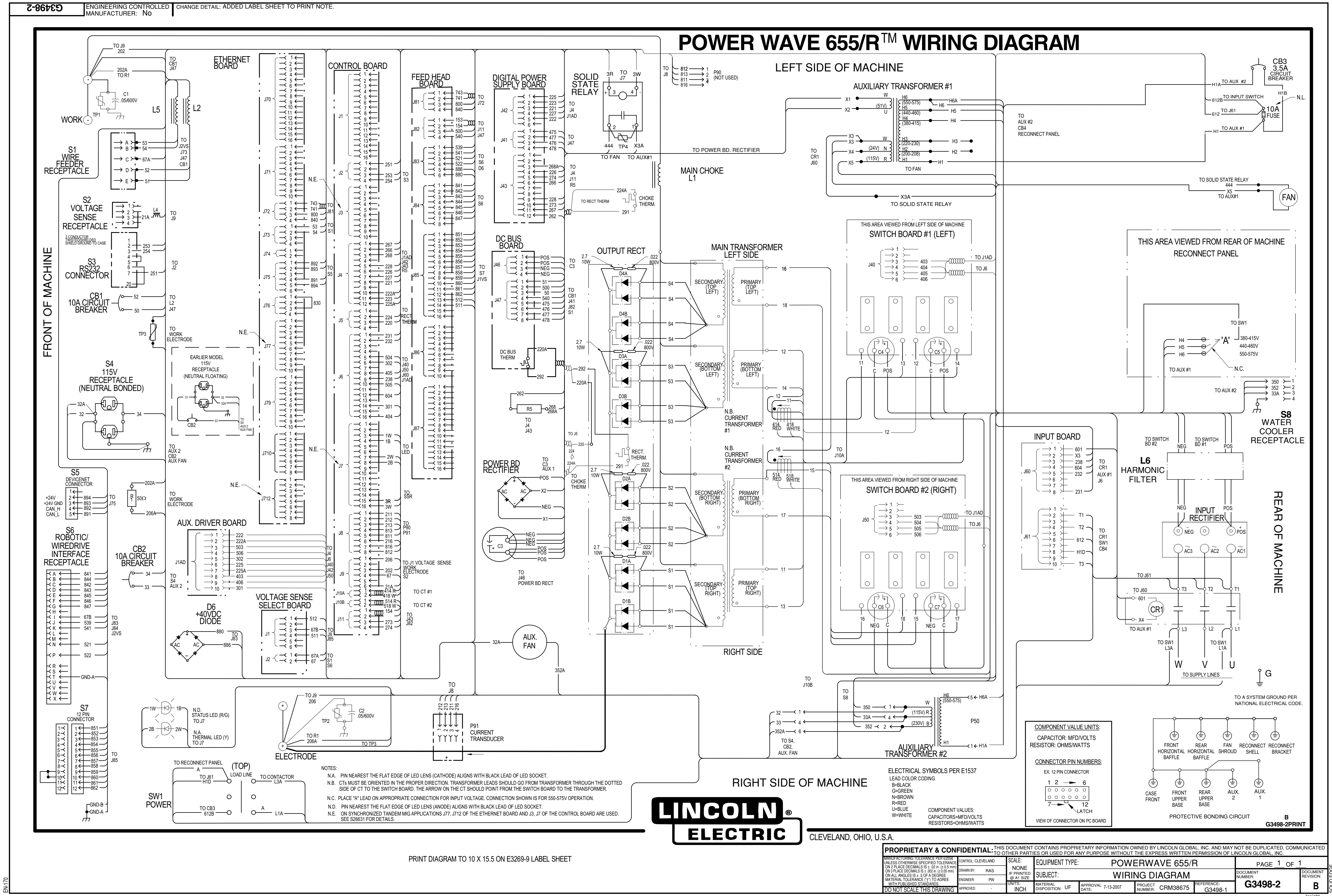
WIRING DIAGRAM - CODE 10863



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual. The wiring diagram specific to your code is pasted inside one of the enclosure panels of your machine.

Return to Section TOC
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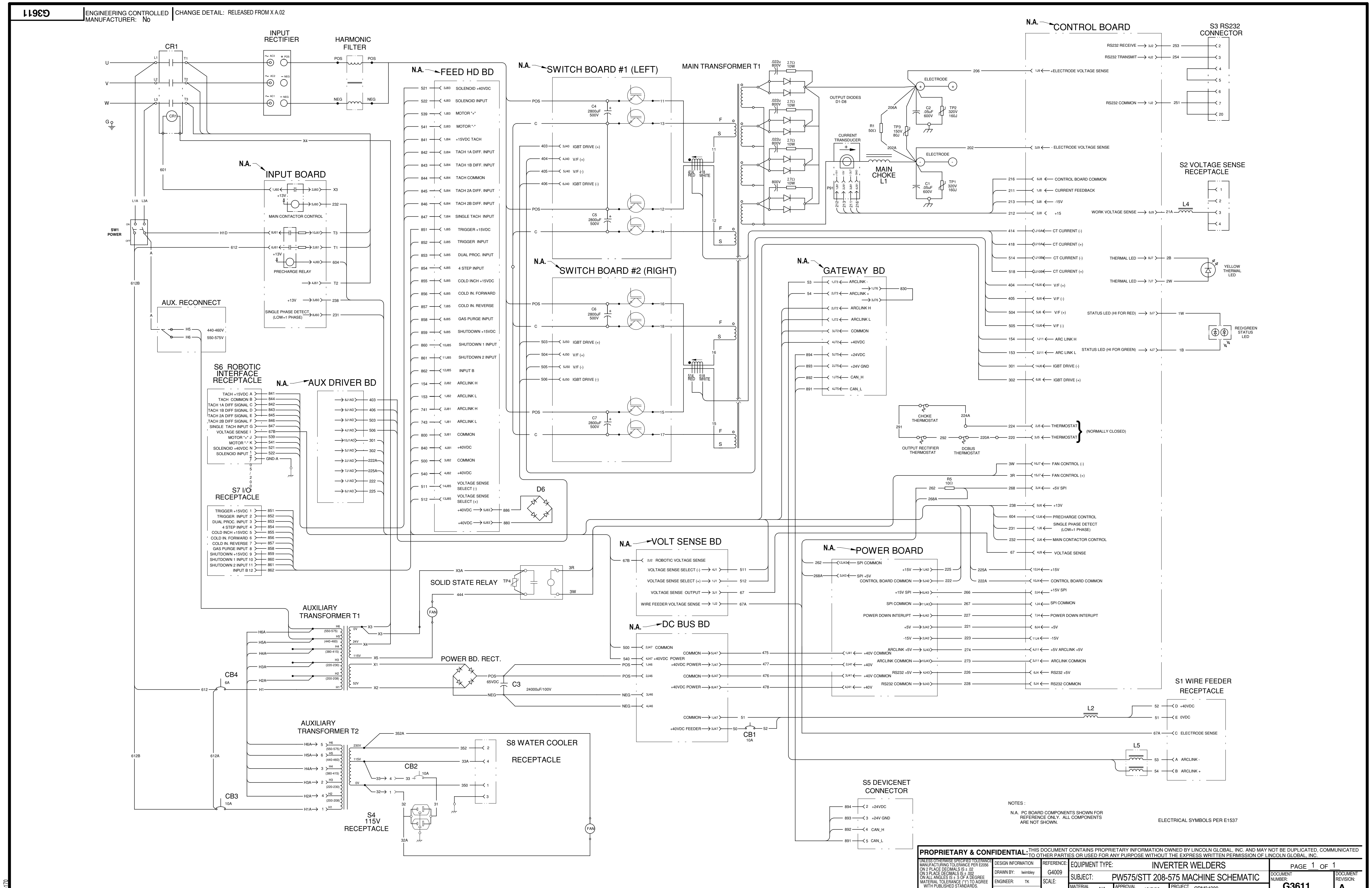
WIRING DIAGRAM - CODE 11410



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual. The wiring diagram specific to your code is pasted inside one of the enclosure panels of your machine.

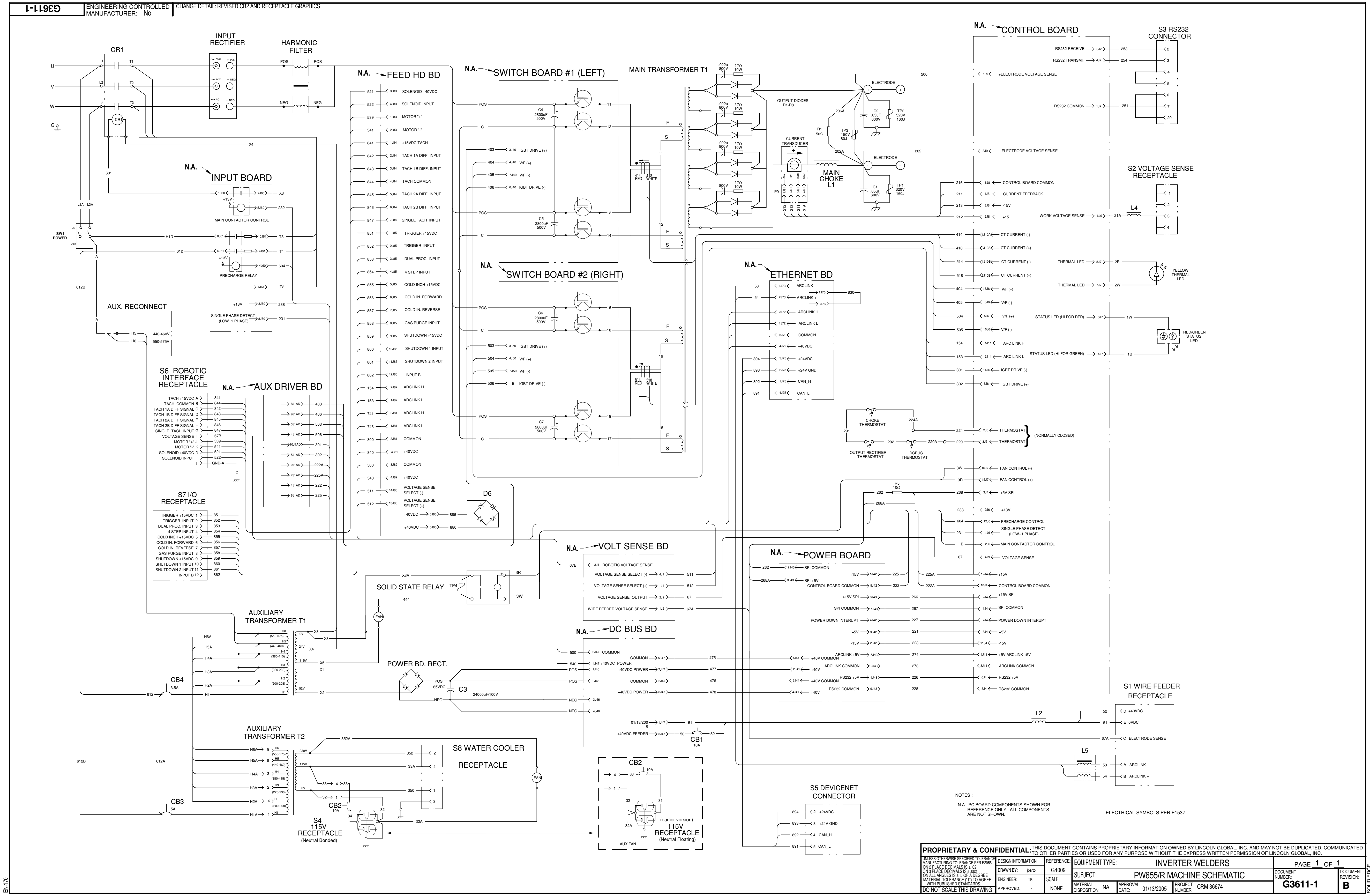
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COMPLETE MACHINE SCHEMATIC - CODE 10630



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

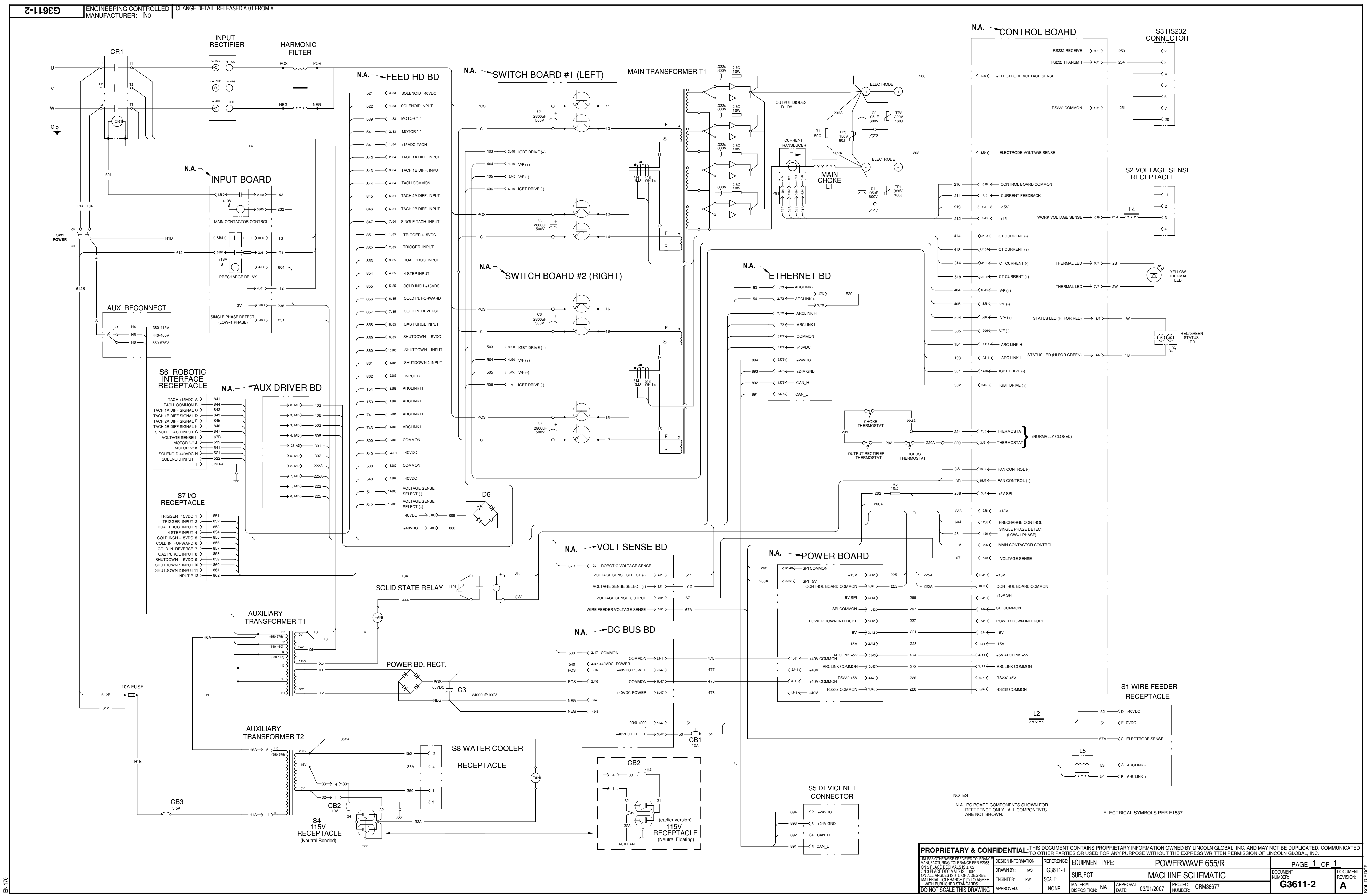
COMPLETE MACHINE SCHEMATIC - CODE 10863



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

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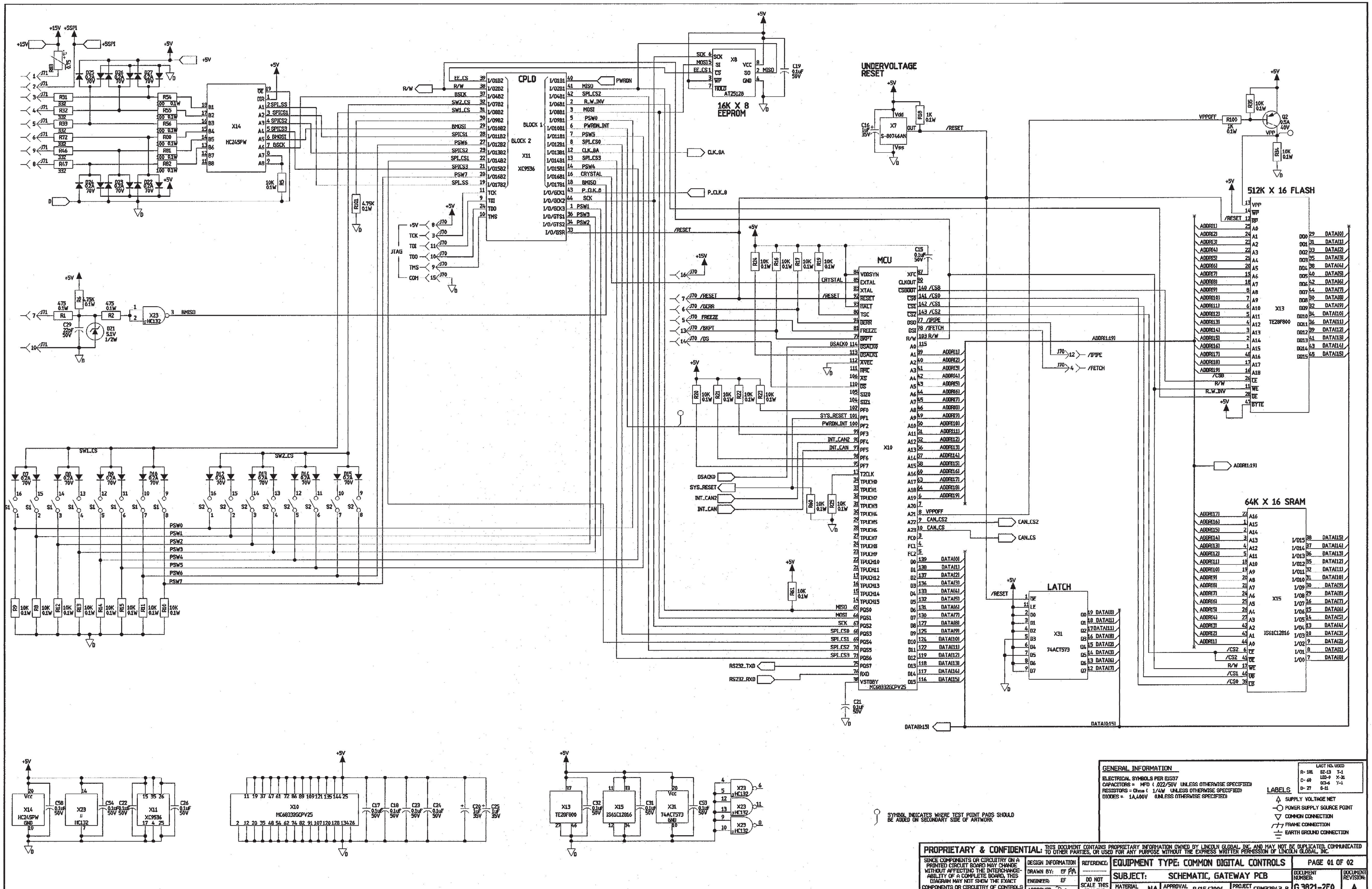
COMPLETE MACHINE SCHEMATIC - CODE 11410



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

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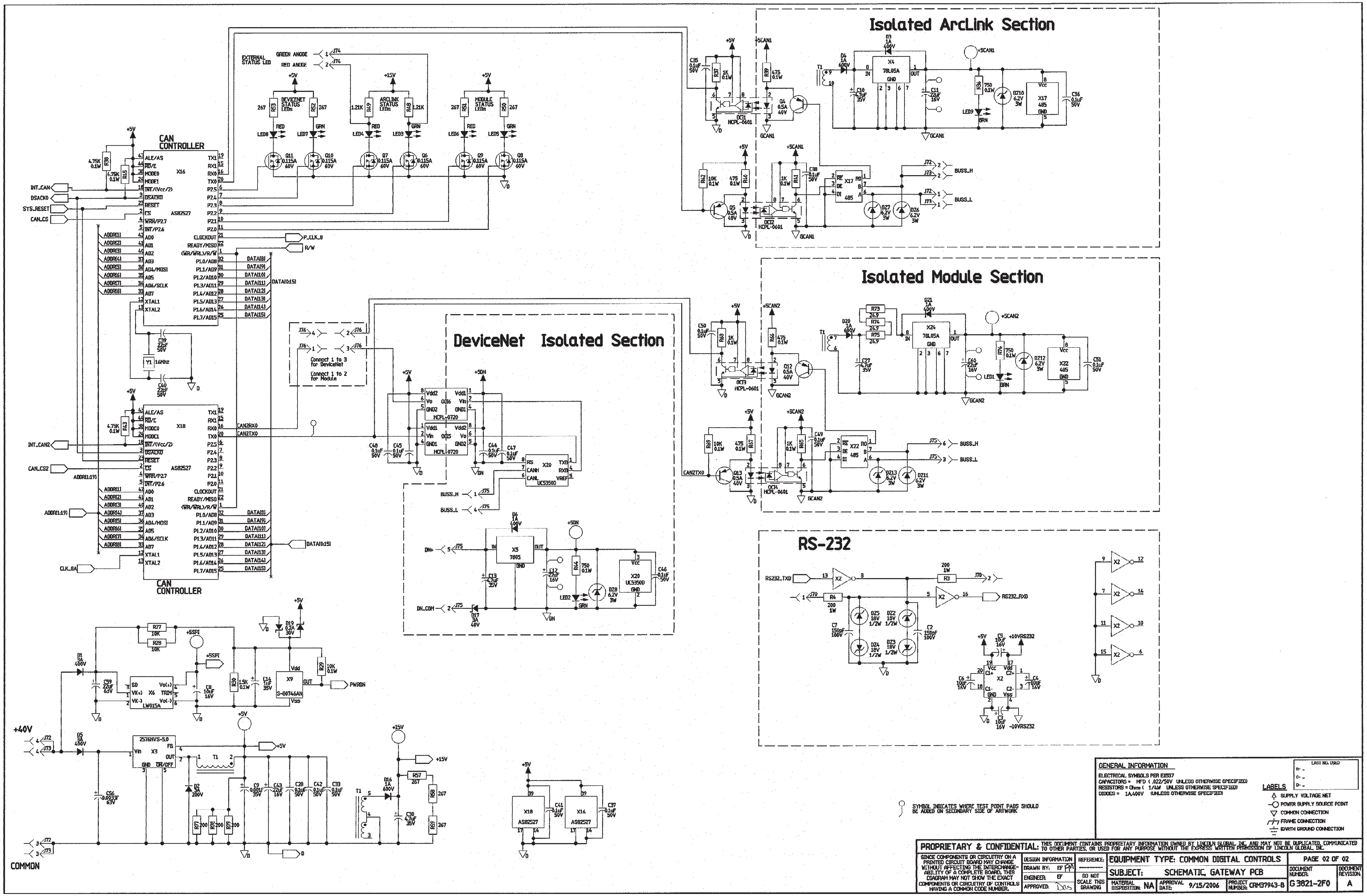
SCHEMATIC - DEVICENET/GATEWAY PC BOARD (SHEET 1)



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

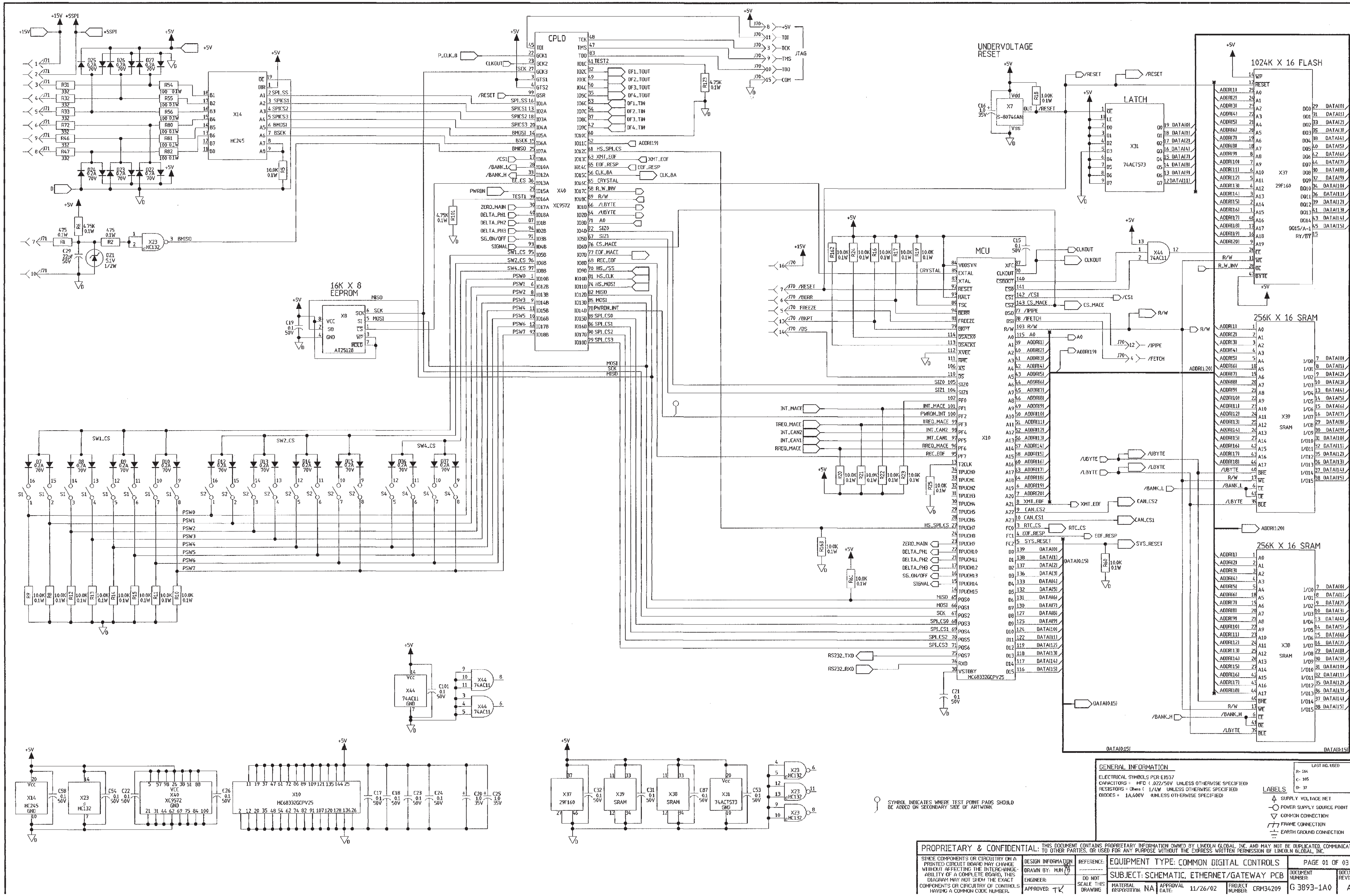
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SCHEMATIC - DEVICENET/GATEWAY PC BOARD (SHEET 2)



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

SCHEMATIC - ETHERNET/GATEWAY PC BOARD (SHEET 1)

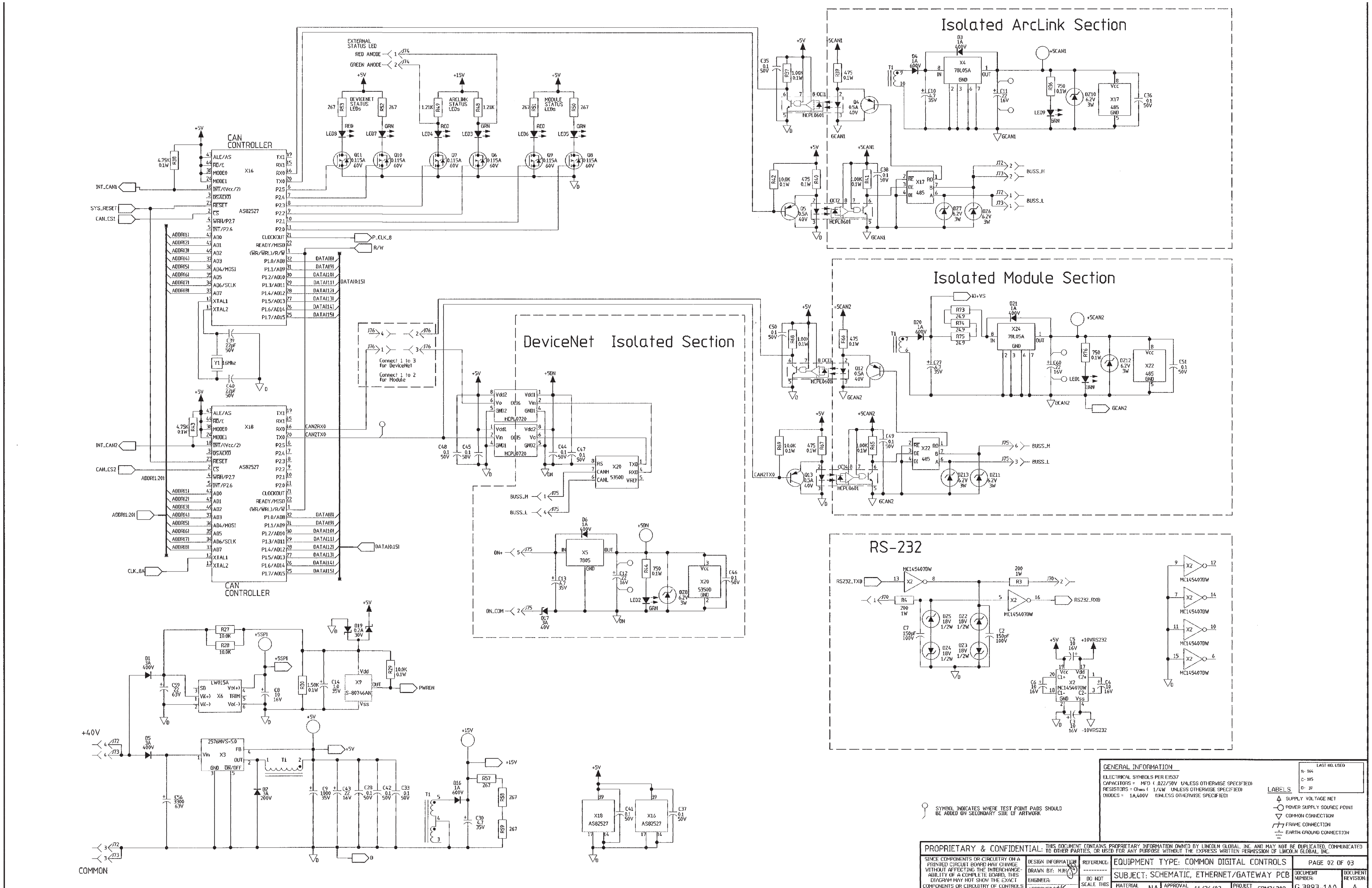


NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

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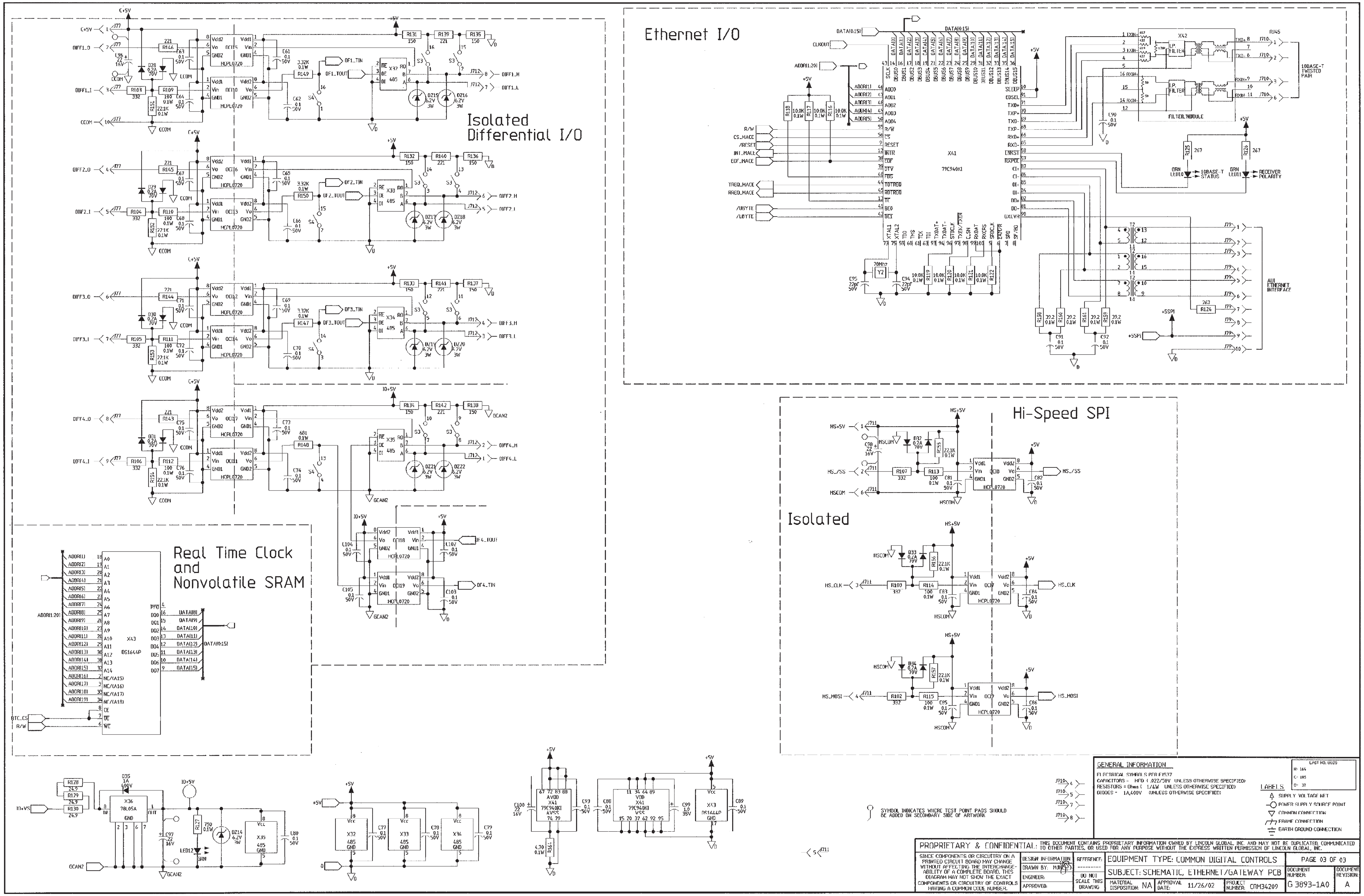
SCHEMATIC - ETHERENET/GATEWAY PC BOARD (SHEET 2)



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

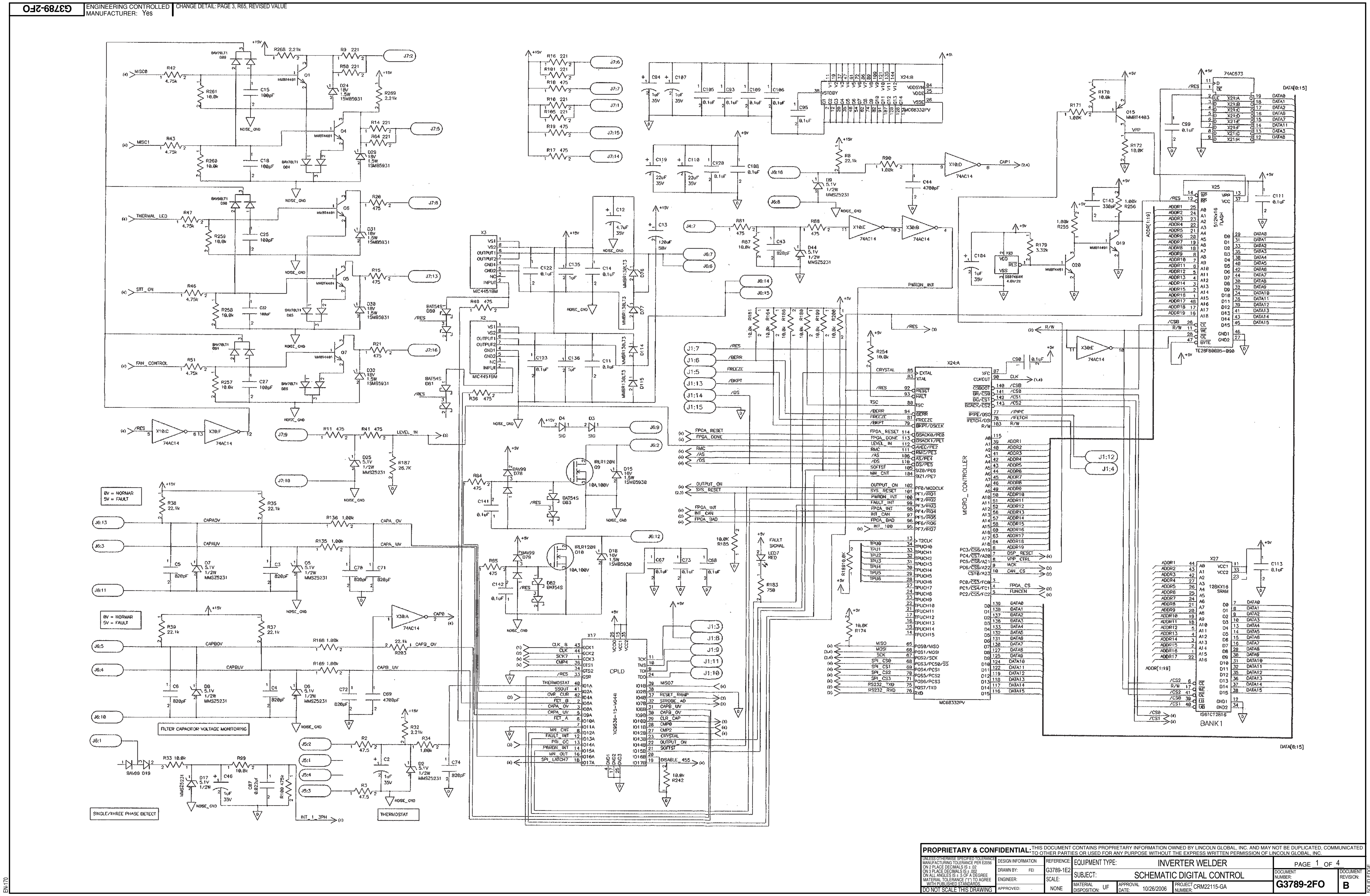
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SCHEMATIC ETHERNET/GATEWAY PC BOARD (SHEET 3)



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

SCHEMATIC - CONTROL PC BOARD (SHEET 1)

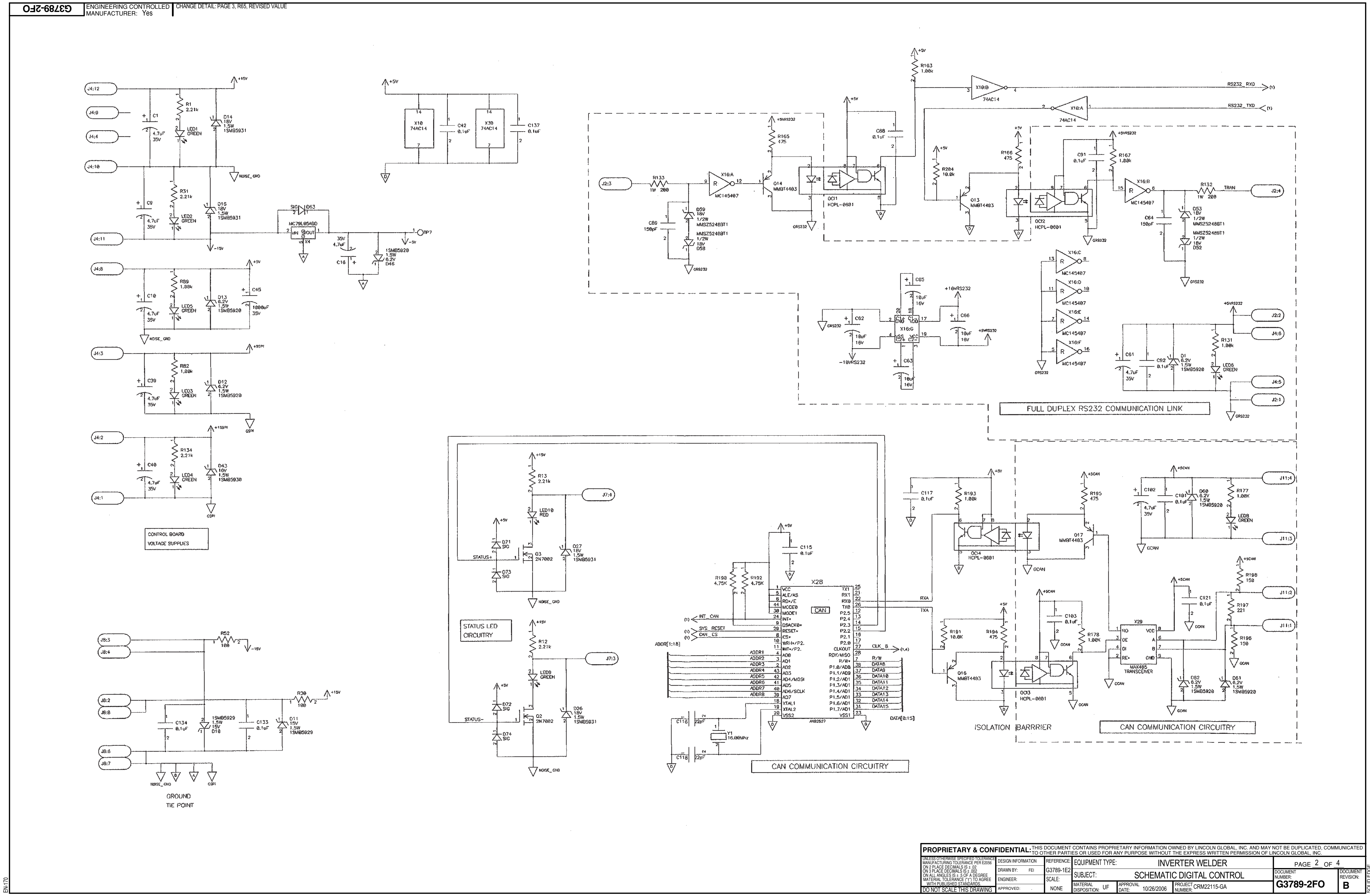


NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

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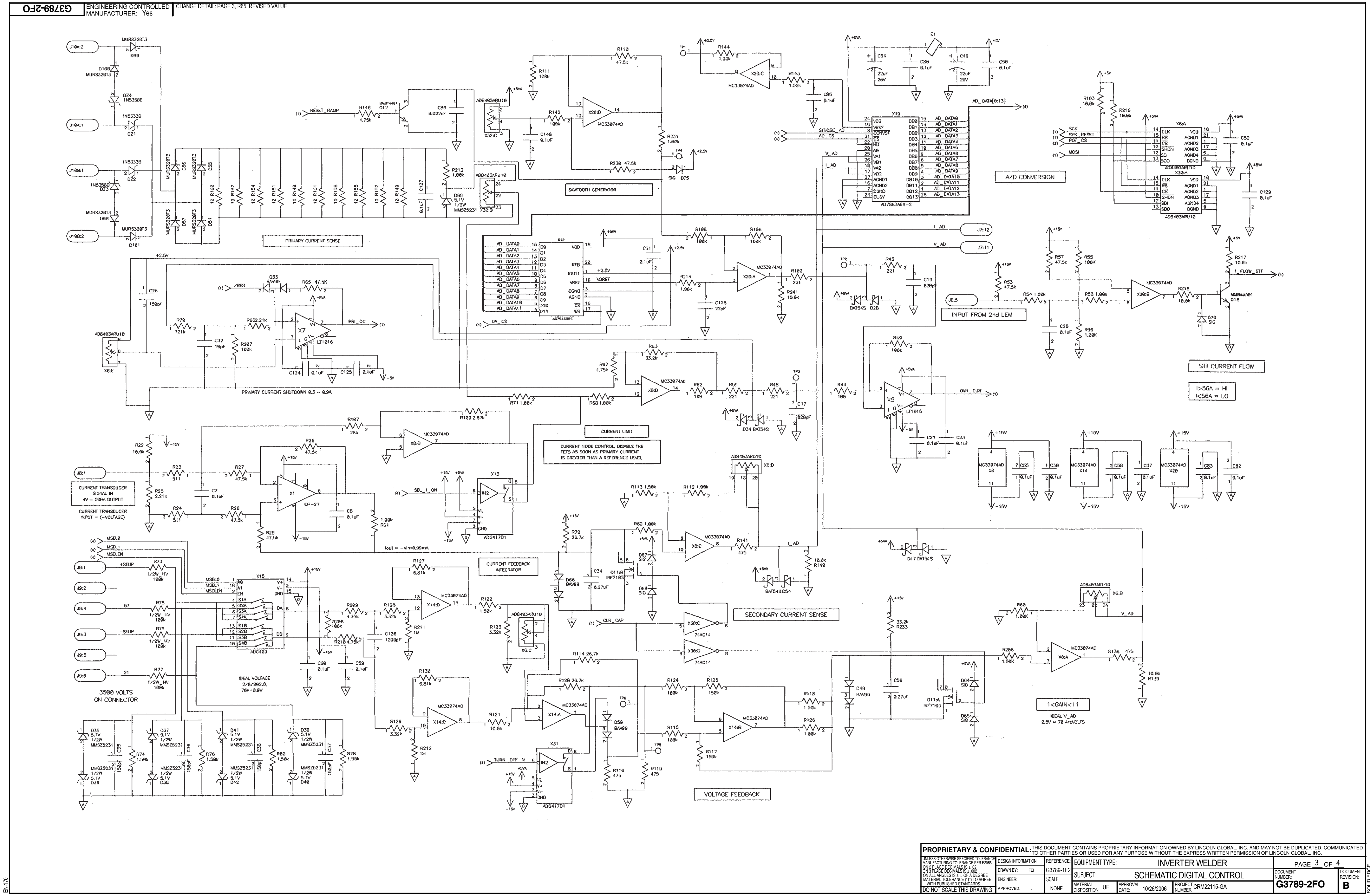
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SCHEMATIC - CONTROL PC BOARD (SHEET 2)



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

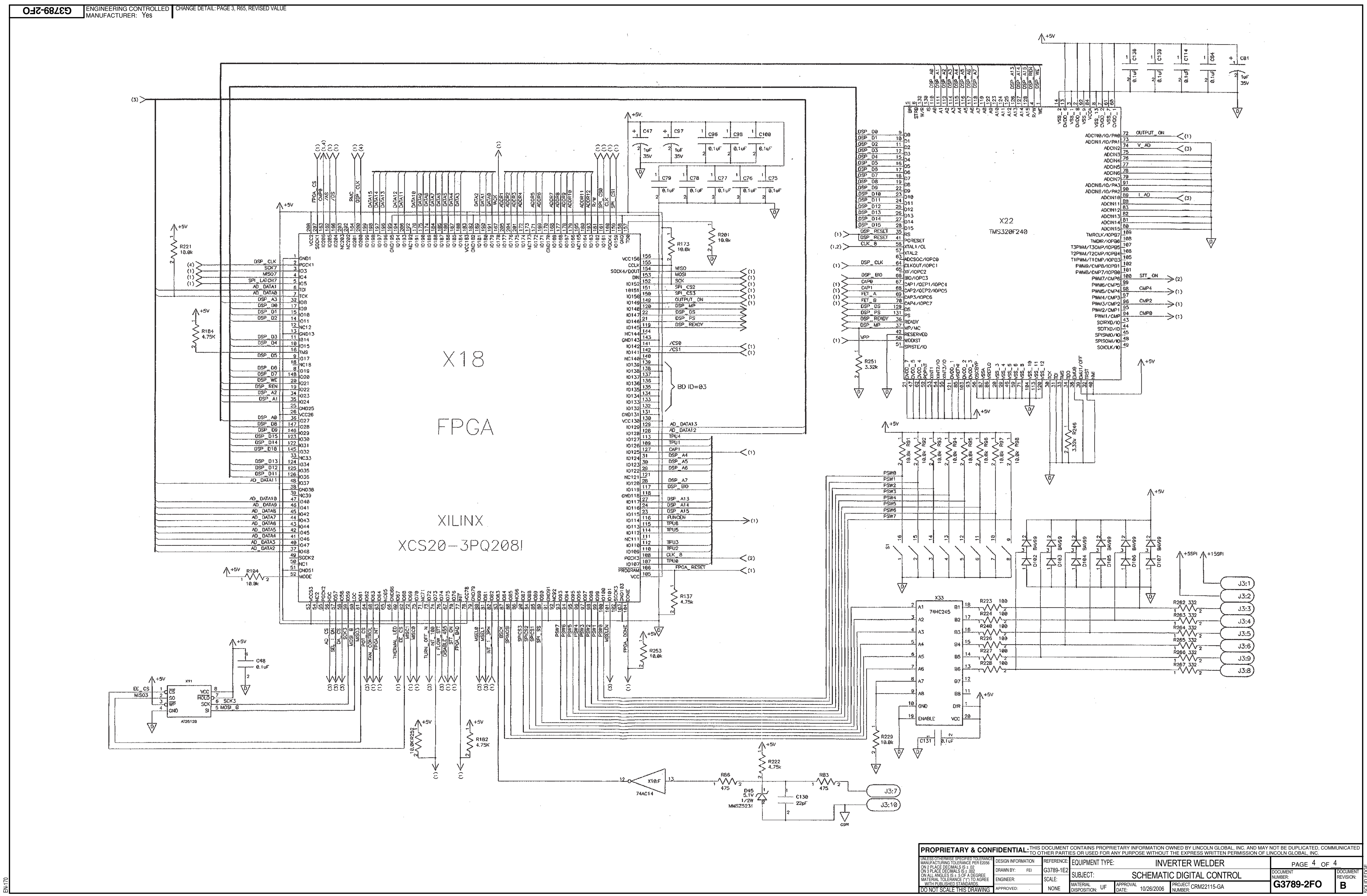
SCHEMATIC - CONTROL PC BOARD (SHEET 3)



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

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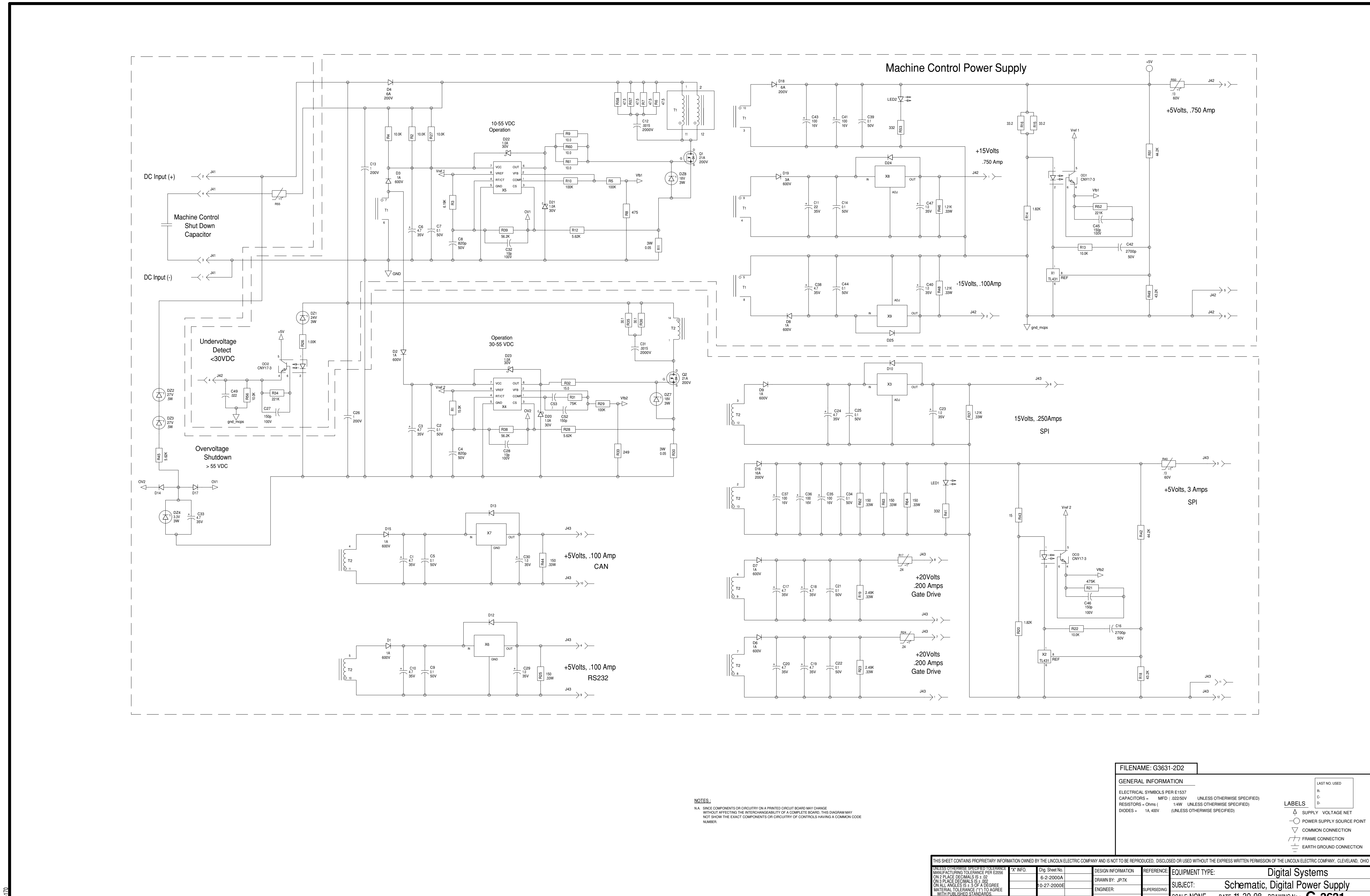
SCHEMATIC - CONTROL PC BOARD (SHEET 4)



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

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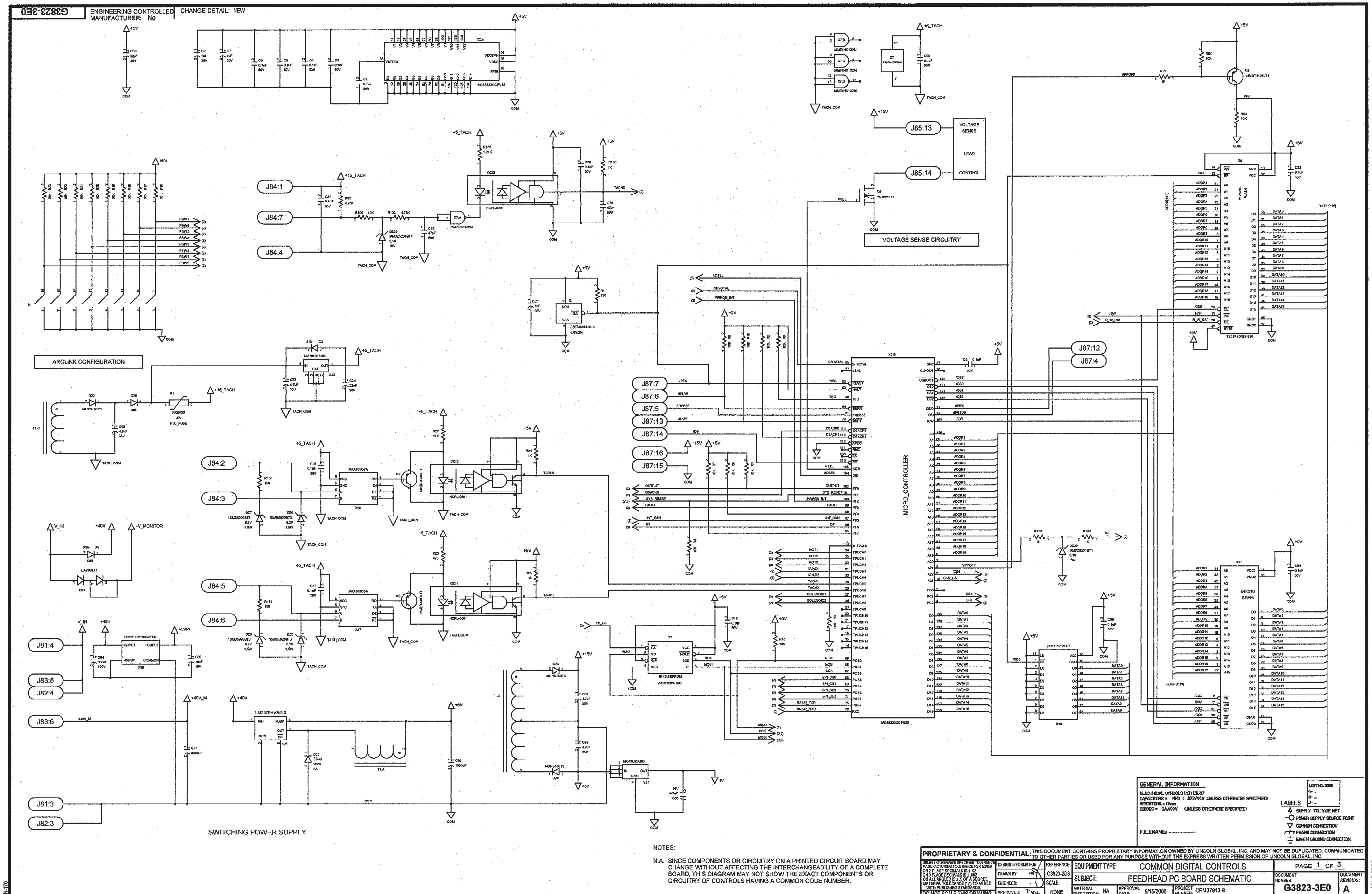
SCHEMATIC - DIGITAL POWER SUPPLY PC BOARD



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

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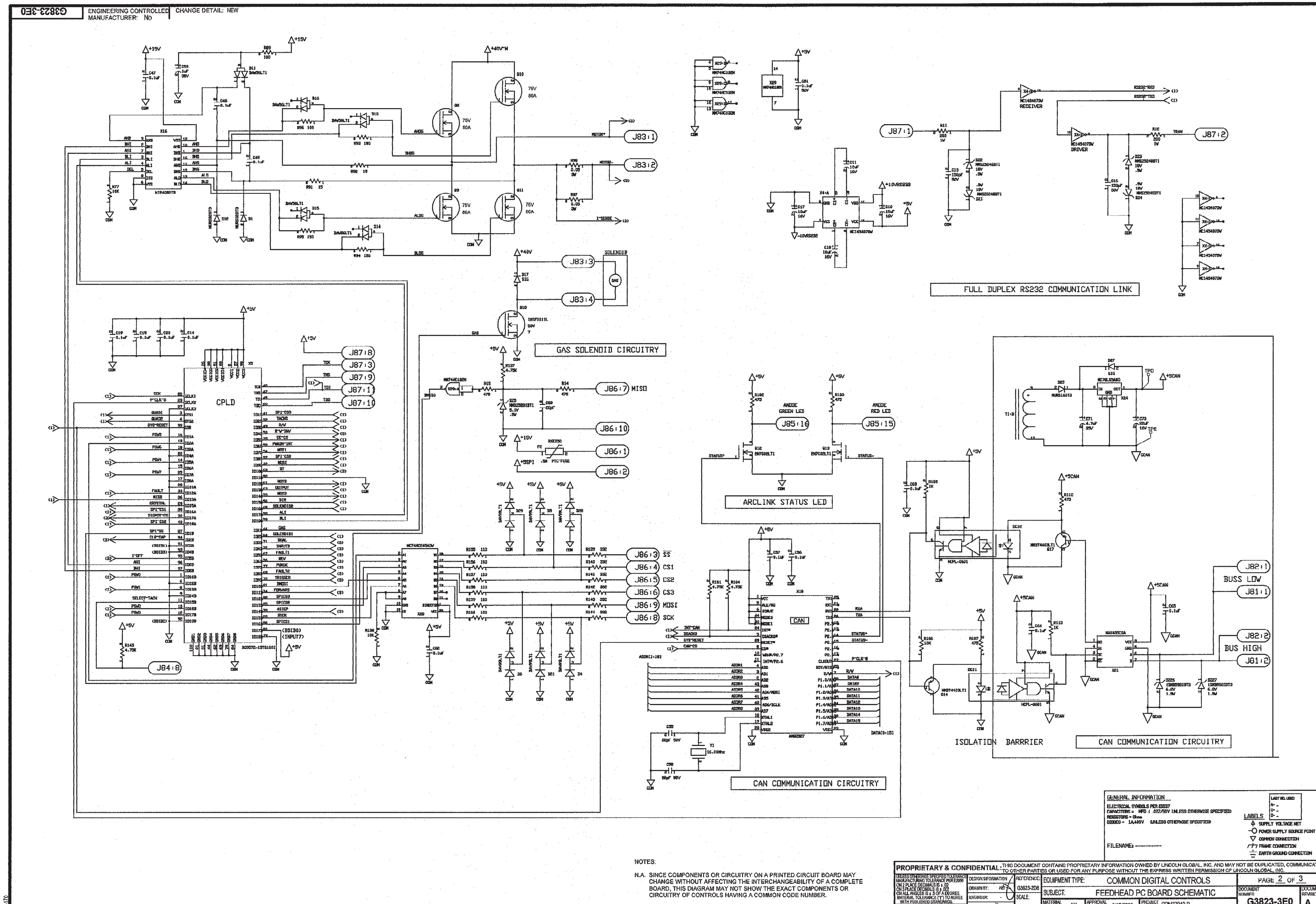
SCHEMATIC - FEED HEAD PC BOARD (SHEET 1)



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

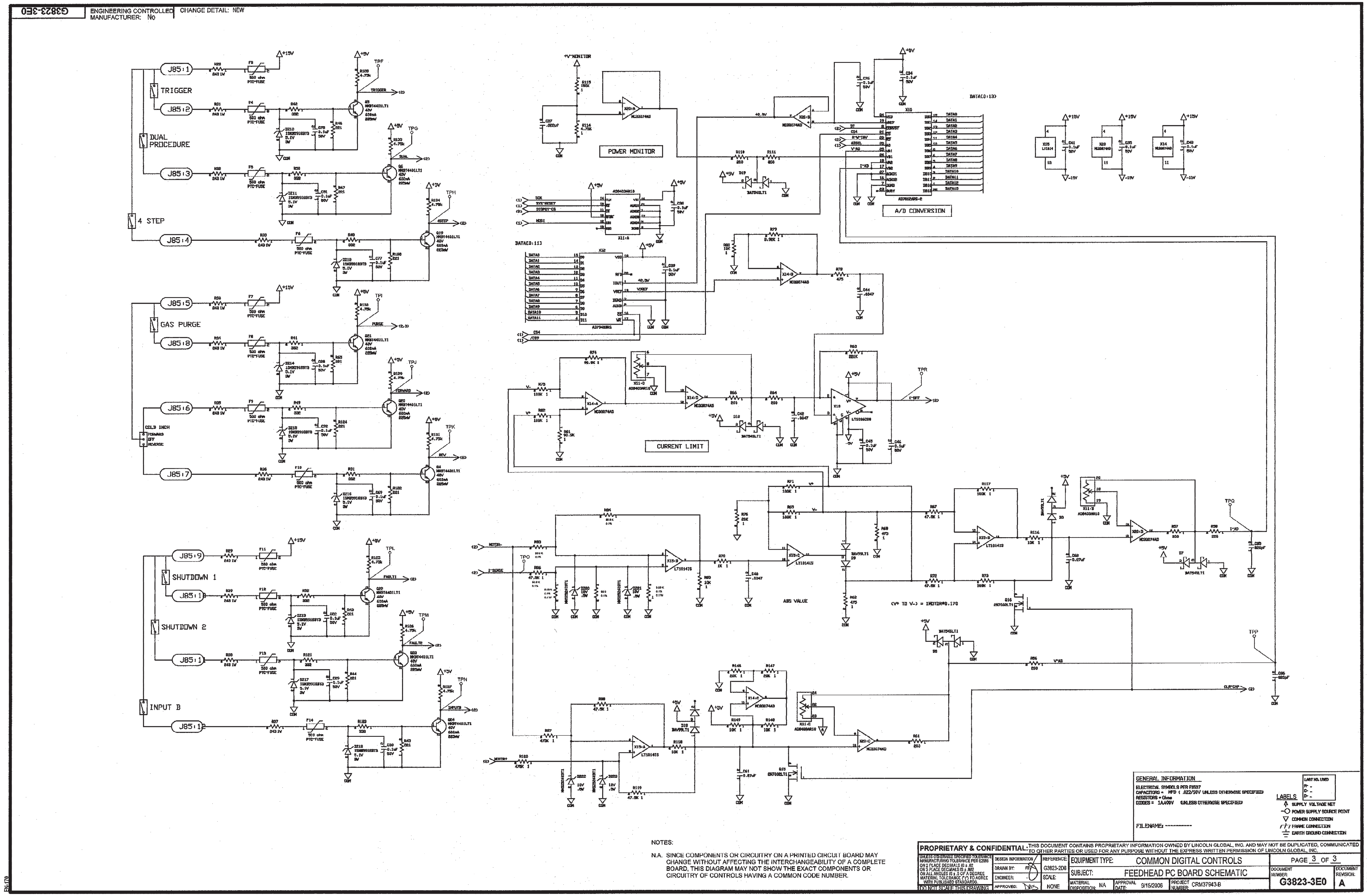
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SCHEMATIC - FEED HEAD PC BOARD (SHEET 2)



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

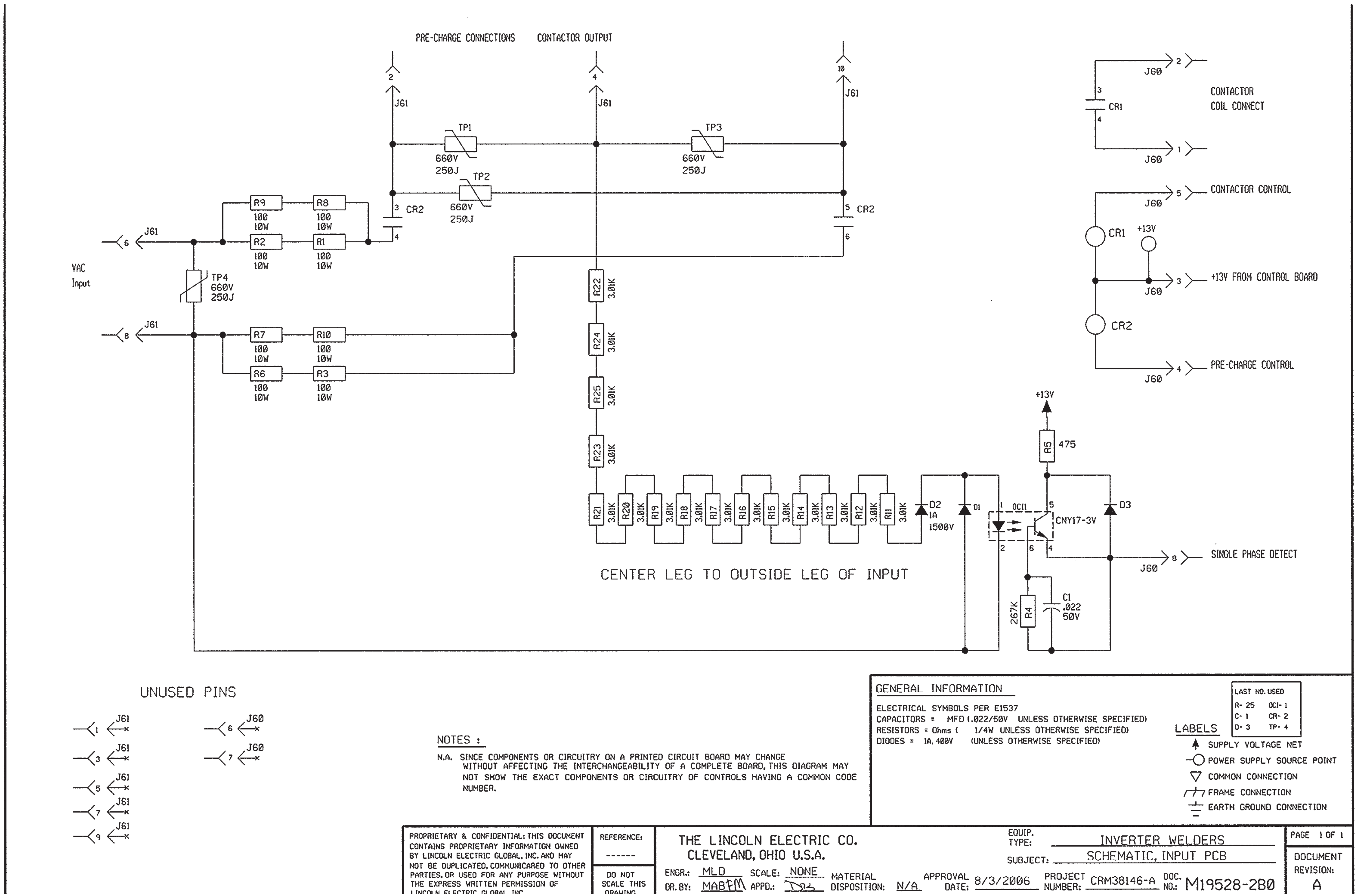
SCHEMATIC - FEED HEAD PC BOARD (SHEET 3)



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

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SCHEMATIC - INPUT PC BOARD



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

PC BOARD ASSEMBLY - INPUT PC BOARD

Return to Section TOC
Return to Master TOC

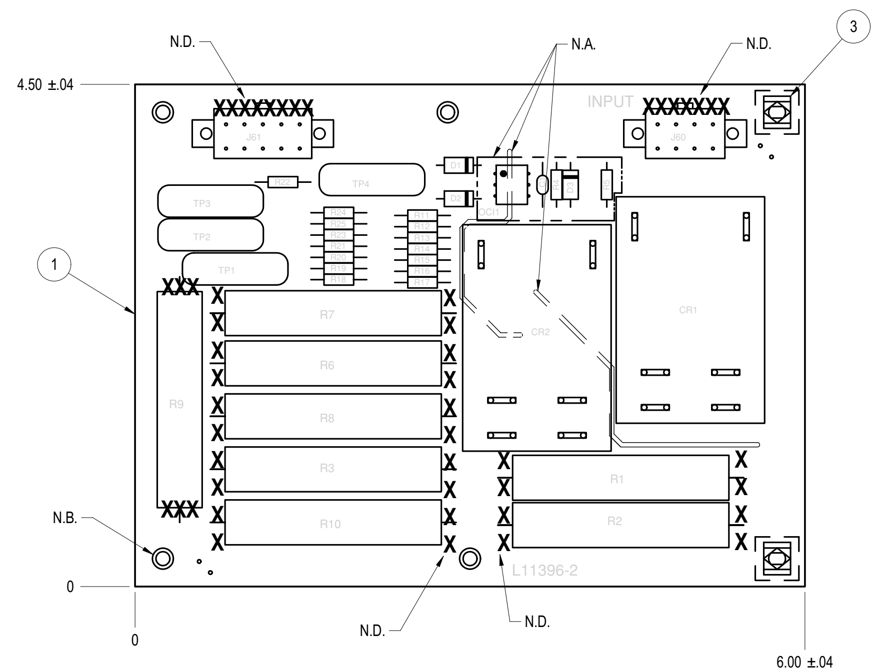
L11396-2

ENGINEERING CONTROLLED
MANUFACTURER: No

CHANGE DETAIL: REVISED MAKE SPECIFICATION

	REFERENCES	QTY	PART NO.	DESCRIPTION
	C1	1	S16668-5	.022/50
	CR1, CR2	2	S14293-18	DPST RELAY
	D1, D3	2	T12199-1	1N4004
	D2	1	T12705-58	DIODE,1.0A,1500V
N.C.	J60	1	S24020-8	HEADER,VERTICAL
N.C.	J61	1	S24020-10	HEADER,VERTICAL
	OCI1	1	S15000-22	OPTO ISOLATOR
	R1, R2, R3, R6, R7, R8, R9, R10	8	S24376-3	100/1OW
	R4	1	S19400-2673	267K 1/4W
	R5	1	S19400-4750	475 1/4W
	R11, R12, R13, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23, R24, R25	15	S19400-3011	3.01K 1/4W
	TP1, TP2, TP3, TP4	4	T13640-23	MOV,250J,660V

P.C. BOARD BLANK INFORMATION
BUY COMPLETE AS L11396-B
(2 LAYER BOARD PER E3281)
(MAKES 8 BOARDS PER PANEL, SEE ELECTRONIC FILE FOR ADDITIONAL INFORMATION)



ITEM	REQ'D	PART NO.	IDENTIFICATION
1	1	SEE BLANK INFO.	P.C. BD. BLANK
2	1.0 OZ.	E2861	SEALANT
3	2	S14020-7	PLASTIC EXPANSION NUT

CAPACITORS = MFD / VOLTS

RESISTORS = OHMS/WATTS

N.A. THIS AREA TO BE COVERED ON BOTH SIDES OF BOARD WITH ITEM 2 PRIOR TO ENCAPSULATION. MATERIAL MUST BE APPLIED THRU SLOTS FROM BOTTOM SIDE TO COMPLETELY FILL TO UNDERSIDE OF DEVICE ON COMPONENT SIDE.

N.B. P.C. BOARD HOLES TO BE FREE OF ENCAPSULATION MATERIAL.

N.C. DO NOT COAT WITH ENCAPSULATION MATERIAL.

N.D. APPLY ITEM 2 AS SHOWN, ALL EXPOSED LEADS MUST BE COVERED. MATERIAL MUST BE APPLIED PRIOR TO ENCAPSULATION.

N.E. APPLY ITEM 2 ON NON-COMPONENT SIDE OF BOARD PRIOR TO ENCAPSULATION. ALL EXPOSED PINS MUST BE COVERED.

MAKE PER E1911-ROHS
ENCAPSULATE WITH E1844
TEST PER E3647-I
SCHEMATIC REFERENCE: M19528-2B0

MANUFACTURED AS:

L11396-2B0

IDENTIFICATION CODE

ALL COMPONENTS AND MATERIALS USED IN THIS ASSEMBLY ARE TO BE RoHS COMPLIANT PER E4253.

UNLESS OTHERWISE SPECIFIED TOLERANCE MANUFACTURING TOLERANCE PER E2056 ON 2 PLACE DECIMALS IS ± .02 ON 3 PLACE DECIMALS IS ± .002 ON ALL ANGLES IS ± .5 OF A DEGREE MATERIAL TOLERANCE ("t") TO AGREE WITH PUBLISHED STANDARDS.
DO NOT SCALE THIS DRAWING

DESIGN INFORMATION
DRAWN BY: FEI
ENGINEER:
APPROVED: -

REFERENCE: L11396-1
SCALE: 1:1

EQUIPMENT TYPE: INVERTER WELDERS
SUBJECT: INPUT P.C. BOARD ASSEMBLY
MATERIAL DISPOSITION: UF
APPROVAL DATE: 3/16/2007
PROJECT NUMBER: CRM34409

PAGE 1 OF 1
DOCUMENT NUMBER: L11396-2
DOCUMENT REVISION: B

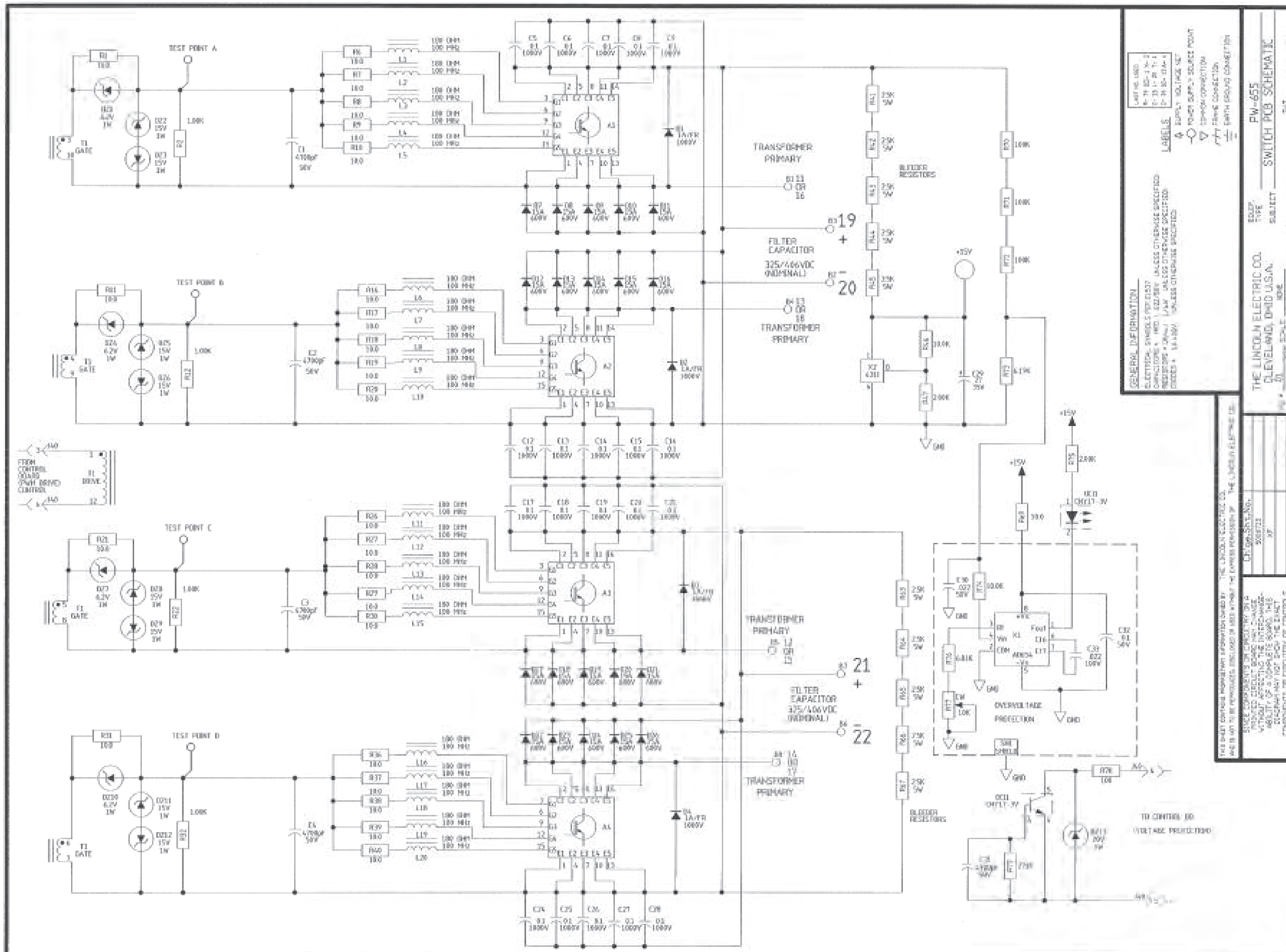
SOLID EDGE

STRP

NOTE: Lincoln Electric assumes no responsibility for liablilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. **Individual Printed Circuit Board Components are not available from Lincoln Electric.** This information is provided for reference only. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

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SCHEMATIC - SWITCH PC BOARD



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

Return to Section TOC
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Return to Master TOC
Return to Section TOC
Return to Master TOC

PC BOARD ASSEMBLY - SWITCH PC BOARD

G3501-1

ENGINEERING CONTROLLED
MANUFACTURER: No

CHANGE DETAIL: REMOVED MFG OPERATION AND W/C TABLE

NOTES:

N.A. CAUTION: THIS DEVICE IS SUBJECT TO DAMAGE BY STATIC ELECTRICITY. SEE E2454 BEFORE HANDLING.

N.B. PC BOARD AND MODULE MOUNTING HOLES TO BE FREE OF ENCAPSULANT MATERIAL FOR A CENTERED 0.50" MIN. DIA. AND 0.55" MAX. DIA. (8 HOLES). MASK PER APPROPRIATE MANUFACTURING WORK INSTRUCTIONS. TO BE CENTERED WITHIN 0.100" (DO NOT GET ON MATING SURFACES).

N.C. MOLEX CAVITIES AND AREA AROUND LOCKING TAB TO BE FREE OF ENCAPSULANT MATERIAL. MASK PER APPROPRIATE MANUFACTURING WORK INSTRUCTIONS.

N.D. FEMALE EYELET TO BE AGAINST THE OPPOSITE COMPONENT SIDE AS SHOWN. EYELET MUST NOT SPIN AFTER CLINCHING.

N.E. SOLDER EYELET SO THAT SOLDER COVERS ENTIRE EYELET AND ALL AROUND EYELET ON OPPOSITE COMPONENT SIDE ONLY. NO ICICLES OR SOLDER BLOBS PERMITTED.

N.F. BAR MUST BE FREE OF ENCAPSULATION MATERIAL ON BOTH SURFACES AROUND MOUNTING HOLES AND ENTIRE LENGTH OF MOUNTING SURFACES. ENCAPSULATION MATERIAL MUST NOT EXTEND BEYOND THE MOUNTING SURFACE PLANE (4 PLACES).

N.G. DO NOT COAT THE TOP SURFACES OR THREADS WITH ENCAPSULANT MATERIAL (4 TERMINALS). MASK PER APPROPRIATE MANUFACTURING WORK INSTRUCTIONS.

N.H. ELECTRONIC MODULES TO BE ASSEMBLED, SOLDERED, AND SEALED TO PC BOARD PER E3875.

N.J. THESE SURFACES MUST BE MAINTAINED CO-PLANAR WITHIN .010" THROUGH ENTIRE SOLDERING AND SEALING PROCESS (4 PLACES).

N.K. INSPECT POWER TERMINAL PER E1880.

N.L. ELECTRONIC MODULES ON A COMMON P.C. BOARD ASSEMBLY TO HAVE VGE (TH) AND VCE (SAT) IN SAME SORT CODE (0.1 VSPAN) AND THE SAME VENDOR CODE.

e.g. M16100-46 X XX XXX......
VENDOR CODE
VCE (SAT)
VGE (TH)

N.M. DO NOT COAT WITH ENCAPSULATION MATERIAL. TOP AND BOTTOM, FOR 0.80" MIN. DIA. AND 0.85" MAX. DIA. MASK PER APPROPRIATE MANUFACTURING WORK INSTRUCTIONS. TO BE CENTERED WITHIN 0.100" (DO NOT GET ON THE MATING SURFACES).

N.N. ENCAPSULATE COMPONENT SIDE OF P.C. BOARD TO A THICKNESS OF .30 +.12/-.00 IN AREA SHOWN.

N.P. ENCAPSULATE OPPOSITE COMPONENT SIDE OF P.C. BOARD TO A THICKNESS OF .25 +.12/-.00.

N.R. ENCAPSULATION MATERIAL MUST EXTEND BEYOND EDGES OF P.C. BOARD .12 +.12/-.00.

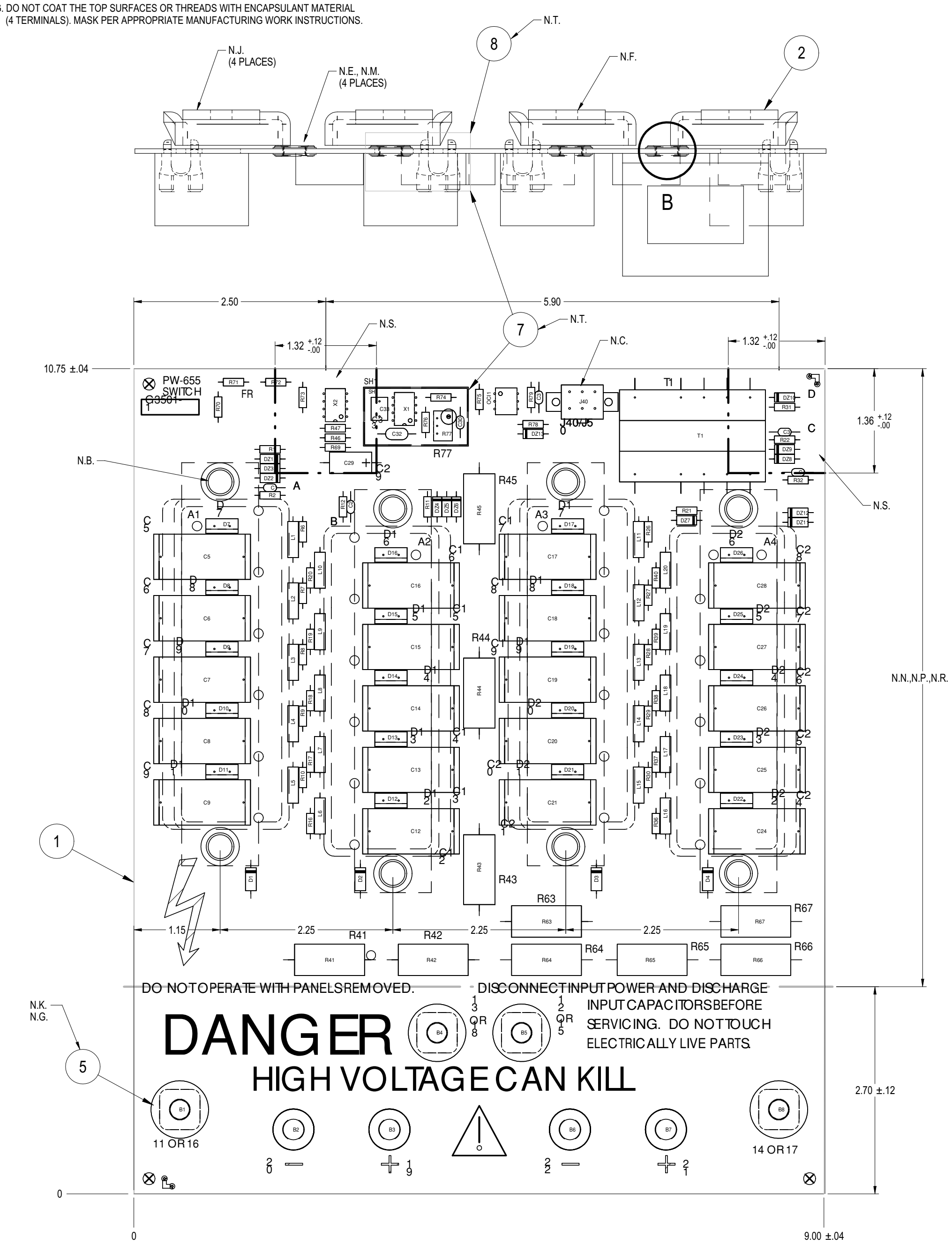
N.S. ENCAPSULATE OPPOSITE COMPONENT SIDE OF P.C. BOARD IN AREAS SHOWN TO A MAXIMUM THICKNESS OF .20.

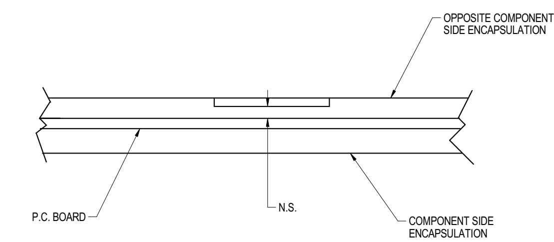
N.T. **ITEM 8** MOUNTS AND SOLDERS TO SAME HOLES AS **ITEM 7**. **ITEM 8** IS MOUNTED ON NON-COMPONENT SIDE OF P.C. BOARD.

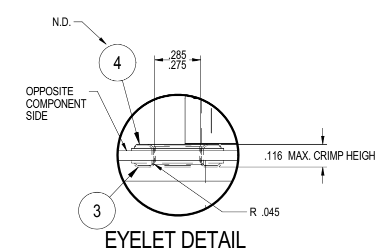
P.C. BOARD BLANK REFERENCE INFORMATION

BUY BLANK COMPLETE AS G3501-F
(4 LAYER BOARD PER E3281)

(MAKES 2 BOARDS PER PANEL, SEE ELECTRONIC FILE FOR ADDITIONAL INFORMATION)
PANEL SIZE PER E1911







MAKE PER E1911
POT PER E1911-E
TEST PER E3826-SW

MANUFACTURED AS:
G3501-1F0
IDENTIFICATION CODE

ITEM	QTY	PART NO.	DESCRIPTION
X1	1	M13552-3	IC, CONVERTER, V/F, 654
T1	1	S13000-46	TRANSFORMER, PCB;
C29	1	S13490-93	CAPACITOR, TAEL, 27, 35V, 10%
OC11	1	S15000-22	OPTOCOUPLER, PHOTO-Q, 70V, CNY17-3/VDE
X2	1	S15128-10	VOLTAGE REF, ADJ, PERCISION, 431I
R77	1	S16296-5	TRIMMER, MT, 1/2W, 10K, 10% , LINEAR
C30	1	S16668-5	CAPACITOR, CEMO, .022, 50V, 20%
C1,C2,C3,C4,C31	5	S16668-6	CAPACITOR, CEMO, 4700p, 50V, 10%
C32	1	S16668-11	CAPACITOR, CEMO, 0.1, 50V, 10%
R1,R6,R7,R8,R9,R10,R11,R16, R17,R18,R19,R20,R21,R26, R27,R28,R29,R30,R31,R36, R37,R38,R39,R40,R69	25	S19400-10R0	RESISTOR, MF, 1/4W, 10.0, 1%
R78	1	S19400-1000	RESISTOR, MF, 1/4W, 100, 1%
R2,R12,R22,R32	4	S19400-1001	RESISTOR, MF, 1/4W, 1.00K, 1%
R46,R74	2	S19400-1002	RESISTOR, MF, 1/4W, 10.0K, 1%
R70,R71,R72	3	S19400-1003	RESISTOR, MF, 1/4W, 100K, 1%
R47,R75	2	S19400-2001	RESISTOR, MF, 1/4W, 2.00K, 1%
R79	1	S19400-2213	RESISTOR, MF, 1/4W, 221K, 1%
R73	1	S19400-6191	RESISTOR, MF, 1/4W, 6.19K, 1%
R76	1	S19400-6811	RESISTOR, MF, 1/4W, 6.81K, 1%
C5,C6,C7,C8,C9,C12,C13,C14, C15,C16,C17,C18,C19,C20, C21,C24,C25,C26,C27,C28	20	S20500-1	CAPACITOR, PPMF, 0.1, 1000V, 10% , BOX
C33	1	S20500-14	CAPACITOR, PPMF, .022, 100V, BOX, 5%
J40	1	S24020-6	CONNECTOR, MOLEX, MINI,PCB, 6-PIN, TIN
L1,L2,L3,L4,L5,L6,L7,L8,L9, L10,L11,L12,L13,L14,L15,L16, L17,L18,L19,L20	20	T12218-15	CHOKE, RF, FERRITE BEAD, 180 OHM
DZ13	1	T12702-4	ZENER DIODE, 1W, 20V, 5% IN4747A
DZ2,DZ3,DZ5,DZ6,DZ8,DZ9, DZ11,DZ12	8	T12702-29	ZENER DIODE, 1W, 15V, 5% IN4744A
DZ1,DZ4,DZ7,DZ10	4	T12702-40	ZENER DIODE, 1W, 6.2V, 5% IN4735A
D7,D8,D9,D10,D11,D12,D13, D14,D15,D16,D17,D18,D19, D20,D21,D22,D23,D24,D25,D26	20	T12705-32	DIODE, T220, 15A, 600V, FR, MUR1560
D1,D2,D3,D4	4	T12705-44	DIODE, AXLDS, 1A, 1000V, FR, 818
R41,R42,R43,R44,R45,R63, R64,R65,R66,67	10	T14648-9	RESISTOR, WW, 5W, 2.5K, 5% , SQ.

CAPACITORS = MFD/VOLTS
RESISTORS = OHMS

ITEM	QTY	PART NO.	DESCRIPTION
1	1	SEE ABOVE	P.C. BOARD BLANK
2	4	M16100-46	ELECTRONIC MODULE (A1,A2,A3,A4) (SS)
3	4	T9147-15	EYELETS (MALE) (B2,B3,B6,B7)
4	4	T9147-11	EYELETS (FEMALE)
5	4	S23006	POWER TERMINAL (B1,B4,B5,B8)
6	430g	E2527	EPOXY ENCAPSULATING RESIN
7	1	S24869-1	PC BOARD SHIELD
8	1	S24869-2	PC BOARD SHIELD

N.A., N.H., N.L. (items 2)

SCHEMATIC REFERENCE: L11016-1F0

FOR PARTS ORDERS OR SUBSIDIARY ORDERS:
INCLUDE (1) S25254PRINT, (1) S25191-1PRINT, (1) T12837-1 AND (4) S25347-2.

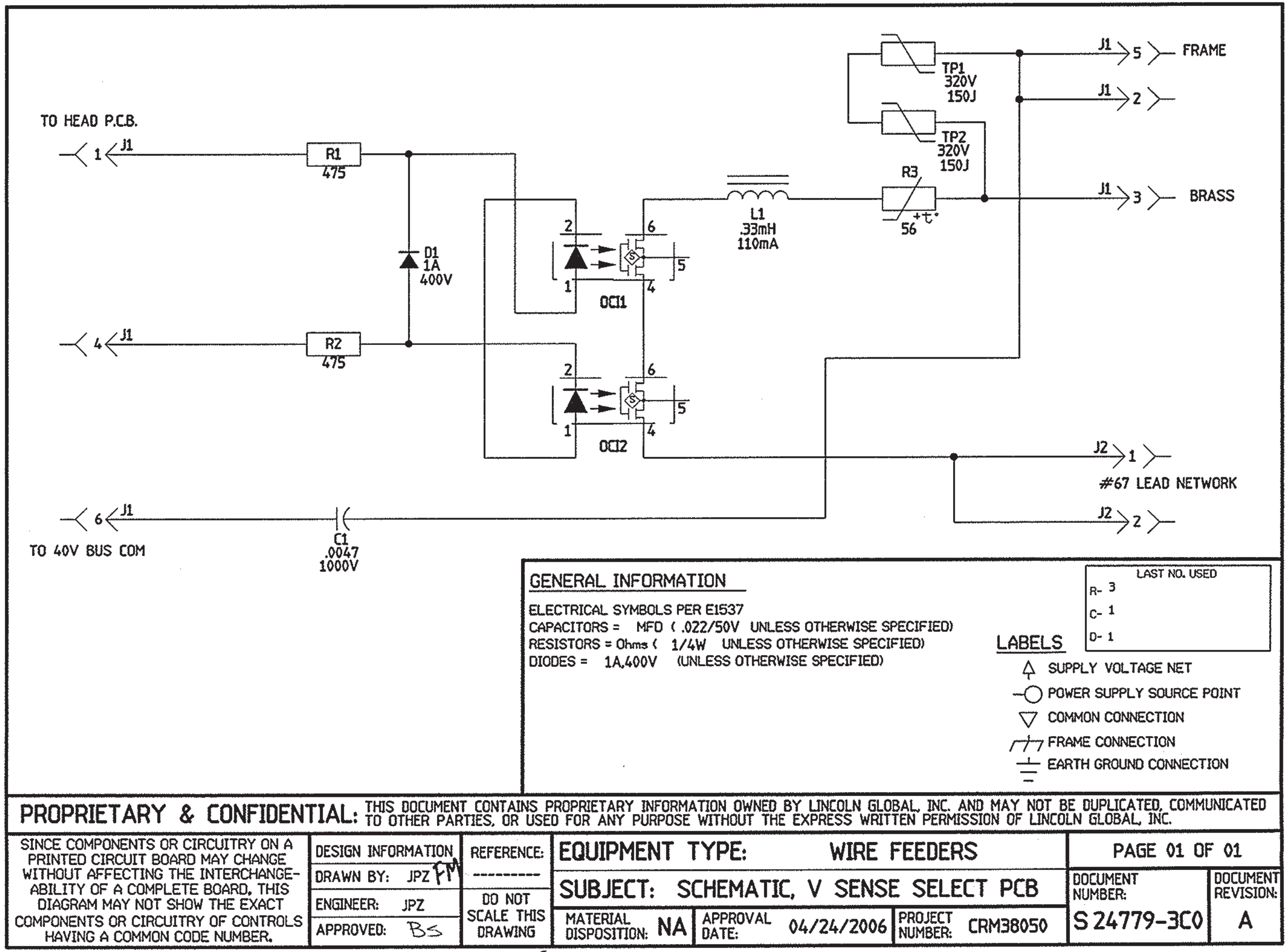
UNLESS OTHERWISE SPECIFIED TOLERANCE MANUFACTURING TOLERANCE PER E2056 ON 2 PLACE DECIMALS IS ± .02 ON 3 PLACE DECIMALS IS ± .002 ON ALL ANGLES IS ± .5 OF A DEGREE MATERIAL TOLERANCE ("t") TO AGREE WITH PUBLISHED STANDARDS.
DO NOT SCALE THIS DRAWING

DESIGN INFORMATION | DRAWN BY: lwimbley | ENGINEER: TK | APPROVED: -
REFERENCE: - | SCALE: 1:1
EQUIPMENT TYPE: INVERTER WELDERS
SUBJECT: SWITCH P.C. BD. AS'BLY
MATERIAL DISPOSITION: UF | APPROVAL DATE: 3/10/2005 | PROJECT NUMBER: CRM35906
PAGE 1 OF 1
DOCUMENT NUMBER: G3501-1 | DOCUMENT REVISION: B
SOLID EDGE
STRP

NOTE: Lincoln Electric assumes no responsibility for liablilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. **Individual Printed Circuit Board Components are not available from Lincoln Electric.** This information is provided for reference only. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

LINCOLN ELECTRIC

SCHEMATIC - VOLTAGE SENSE PC BOARD



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

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Return to Section TOC
Return to Master TOC

PC BOARD ASSEMBLY - VOLTAGE SENSE PC BOARD

M19540-3

ENGINEERING CONTROLLED MANUFACTURER: No

CHANGE DETAIL: REVISED MAKE SPECIFICATION

	ITEM	REQD	PART NO.	IDENTIFICATION
	C1	1	S20500-4	.0047 1000V
	D1	1	T12199-1	1N4004
N.A.	J1	1	S24020-6	HEADER
N.A.	J2	1	S24020-2G	HEADER
	L1	1	T12218-7	330uH
	OCI1,OCI2	2	S15000-20	PHOTO FET
	R1,R2	2	S19400-4750	475 1/4W
	R3	1	S18380-1	THERMISTOR,PTC
	TP1,TP2	2	T13640-18	160J

P.C. BOARD BLANK INFORMATION
BUY COMPLETE AS M19540-C
(2 LAYER BOARD PER E3281)
(MAKES 54 BOARDS PER PANEL, SEE ELECTRONIC FILE FOR ADDITIONAL INFORMATION)

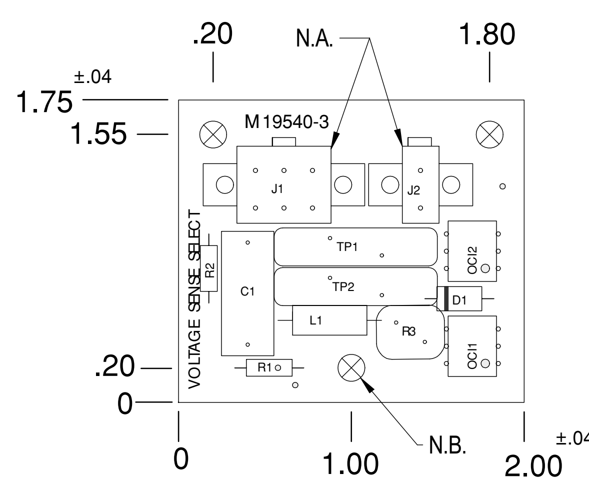
CAPACITORS = MFD/VOLTS
RESISTORS = OHMS
INDUCTANCE = HENRYS

ITEM	REQD	PART NO.	DESCRIPTION
1	1	SEE BLANK INFO	P.C. BOARD BLANK

SCHEMATIC REFERENCE: S24779-3CO

N.A. DO NOT COAT WITH ENCAPSULATION MATERIAL.

N.B. DO NOT COAT WITH ENCAPSULATION MATERIAL .23 MIN. DIA. (3 PLACES) ON NON COMPONENT SIDE.



MAKE PER E1911-ROHS
ENCAPSULATE WITH E1844 (2 DIPS)
TEST PER E3689-VS

MANUFACTURED AS

M19540-3CO

IDENTIFICATION CODE

ALL COMPONENTS AND MATERIALS USED IN THIS ASSEMBLY ARE TO BE RoHS COMPLIANT PER E4253.

UNLESS OTHERWISE SPECIFIED TOLERANCE
MANUFACTURING TOLERANCE PER E2056
ON 2 PLACE DECIMALS IS ± .02
ON 3 PLACE DECIMALS IS ± .002
ON ALL ANGLES IS ± .5 OF A DEGREE
MATERIAL TOLERANCE ("t") TO AGREE WITH PUBLISHED STANDARDS.
DO NOT SCALE THIS DRAWING

DESIGN INFORMATION
DRAWN BY: FEI
ENGINEER:
APPROVED: -

REFERENCE: M19540-2
SCALE: 1:1

EQUIPMENT TYPE: COMMON DIGITAL CONTROLS
SUBJECT: VOLTAGE SENSE PC BRD AS'BLY
MATERIAL DISPOSITION: UF
APPROVAL DATE: 3/16/2007
PROJECT NUMBER: CRM34409

PAGE 1 OF 1
DOCUMENT NUMBER: M19540-3
DOCUMENT REVISION: C

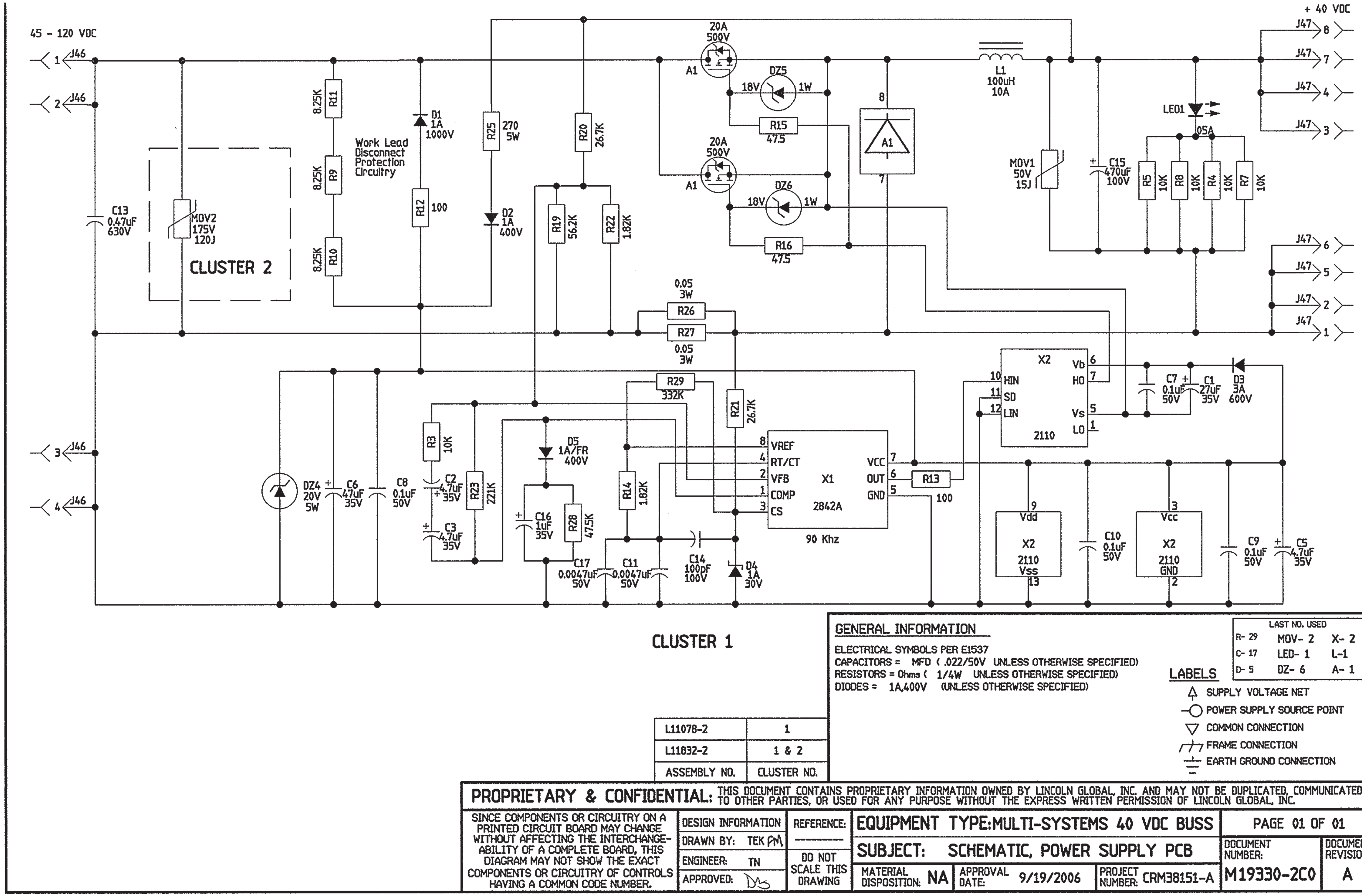
SOLID EDGE

STRP

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Return to Master TOC
Return to Section TOC
Return to Master TOC

SCHEMATIC - 40VDC BUS PC BOARD



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

PC BOARD ASSEMBLY - 40VDC BUS PC BOARD

L11745-1

ENGINEERING CONTROLLED MANUFACTURER: **No**

CHANGE DETAIL: **NEW**

ITEM	PART NO.	DESCRIPTION	QTY
1	M19559	HEAT SINK	1
2	L11078-2	40V DC BUS P.C. BD. ASSEMBLY	1
	S25930-1	TORZ BUTTON HEAD SCREW	2
	S9262-23	PLAIN WASHER	2
	CF000017	1/4-20HN	2
	E2529	JOINT COMPOUND	.004 OZ.
* 3	E1777-2	RETAINING COMPOUND (LOCTITE 242)	2 cc
4	T13359-12	THERMOSTAT	1
	S8025-80	SELF TAPPING SCREW	2
	E2529	ELECTRICAL JOINT COMPOUND	.001 .OZ

* THESE ITEMS NOT SHOWN

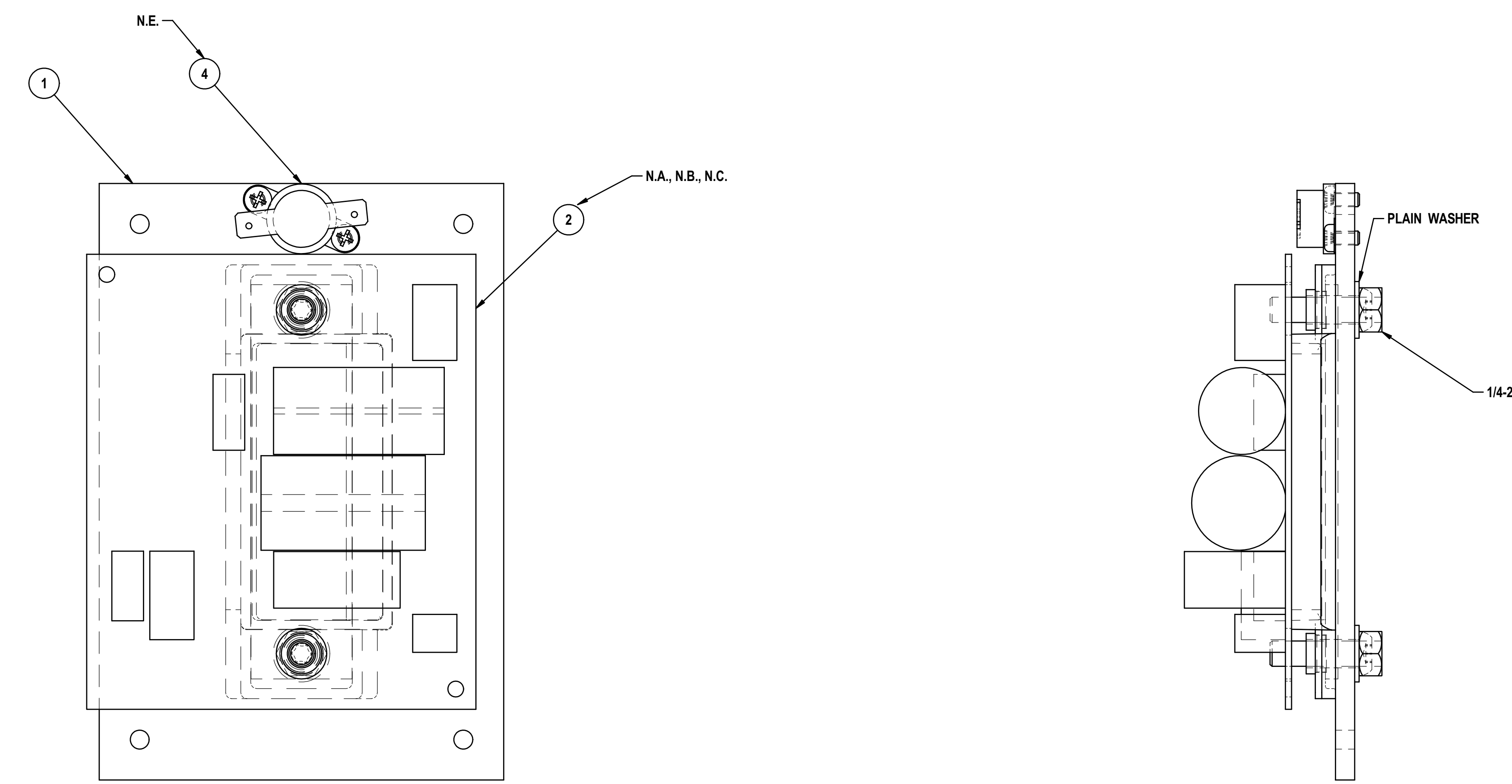
NOTES:

N.A. ASSEMBLE ITEM 2 WITH HEADERS LOCATED AS SHOWN.

N.B. MOUNT THE DC BUS & TIGHTEN THE MODULES PER E3875.

N.C. APPLY A SMALL DROP OF ITEM 3 TO THE FIRST 2-3 THREADS OF THE SOCKET HEAD CAP SCREW.

N.E. APPLY FILM OF COMPOUND TO MOUNTING SURFACE OF ITEM 4 THERMOSTAT.
MOUNT WITH TERMINALS POSITIONED AS SHOWN.



CAUTION: THIS DEVICE IS SUBJECT TO DAMAGE BY STATIC ELECTRICITY. SEE E2454 BEFORE HANDLING.

FOR PARTS ORDERS ONLY
INCLUDE S25251 INSULATION

MANUFACTURING TOLERANCE PER E2056
UNLESS OTHERWISE SPECIFIED TOLERANCE:
ON 2 PLACE DECIMALS IS ± .02 in. (± 0.5 mm)
ON 3 PLACE DECIMALS IS ± .002 in. (± 0.05 mm)
ON ALL ANGLES IS ± .5 OF A DEGREE
MATERIAL TOLERANCE ("t") TO AGREE WITH PUBLISHED STANDARDS.
DO NOT SCALE THIS DRAWING

DESIGN INFORMATION
DRAWN BY: FEI
ENGINEER:
APPROVED: -

SCALE: 1:1 IF PRINTED @ A2 SIZE
UNITS: INCH

EQUIPMENT TYPE: **INVERTER WELDERS**
SUBJECT: **EXCITER BOARD MODULE ASSEMBLY**
MATERIAL DISPOSITION: NA
APPROVAL DATE: 8/9/2006
PROJECT NUMBER: CRM38081
REFERENCE: L11745

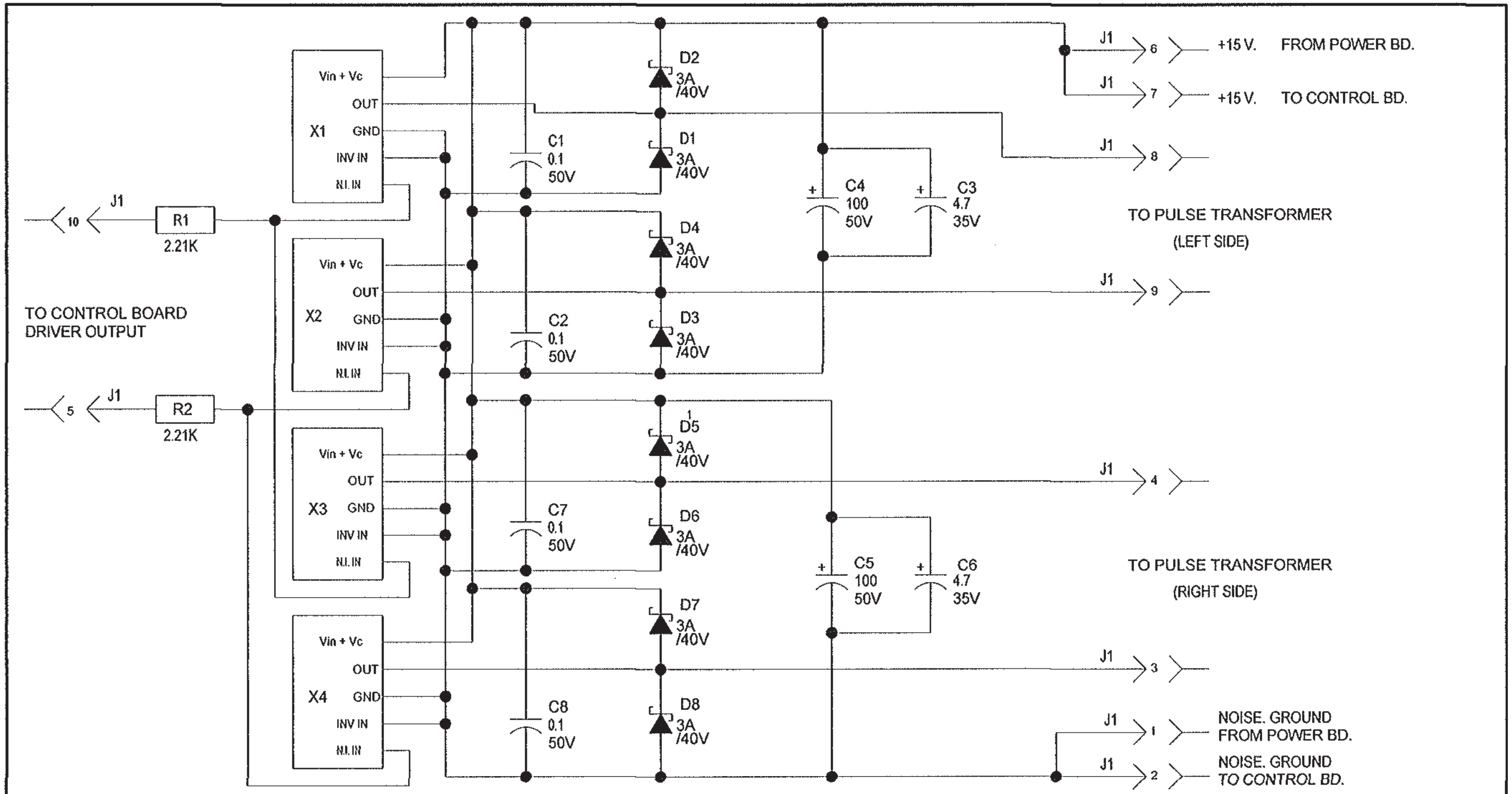
PAGE 1 OF 1
DOCUMENT NUMBER: L11745-1
DOCUMENT REVISION: A

SOLID EDGE

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Return to Master TOC

SCHEMATIC - AUXILIARY DRIVER PC BOARD



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NOTES :

N.A. SINCE COMPONENTS OR CIRCUITRY ON A PRINTED CIRCUIT BOARD MAY CHANGE WITHOUT AFFECTING THE INTERCHANGEABILITY OF A COMPLETE BOARD, THIS DIAGRAM MAY NOT SHOW THE EXACT COMPONENTS OR CIRCUITRY OF CONTROLS HAVING A COMMON CODE NUMBER.

GENERAL INFORMATION

ELECTRICAL SYMBOLS PER E1537
CAPACITORS = MFD (.022/50V UNLESS OTHERWISE SPECIFIED)
RESISTORS = Ohms (1/4W UNLESS OTHERWISE SPECIFIED)
DIODES = 1A, 400V (UNLESS OTHERWISE SPECIFIED)

LABELS

SUPPLY VOLTAGE NET
POWER SUPPLY SOURCE POINT
COMMON CONNECTION
FRAME CONNECTION
EARTH GROUND CONNECTION

file name S24530-1AB

UNLESS OTHERWISE SPECIFIED TOLERANCE
ON HOLES SIZES PER E-2056
ON 2 PLACE DECIMALS IS ± .02
ON 3 PLACE DECIMALS IS ± .002
ON ALL ANGLES IS ± .5 OF A DEGREE
MATERIAL TOLERANCE ("t") TO AGREE
WITH PUBLISHED STANDARDS

THE LINCOLN ELECTRIC CO.
CLEVELAND, OHIO U.S.A.

EQUIP. TYPE AUX_DRIVER P.C. BOARD
SUBJECT SUB: SCHEMATIC
SCALE NONE
DR. LJB APP. DATE 12-20-02 CHK. TK SUP'S'D'G.
SHT. NO. S 24530
REV. A

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

Return to Section TOC
Return to Master TOC

PC BOARD ASSEMBLY - AUXILIARY DRIVER PC BOARD

L11067-1

ENGINEERING CONTROLLED
MANUFACTURER: No

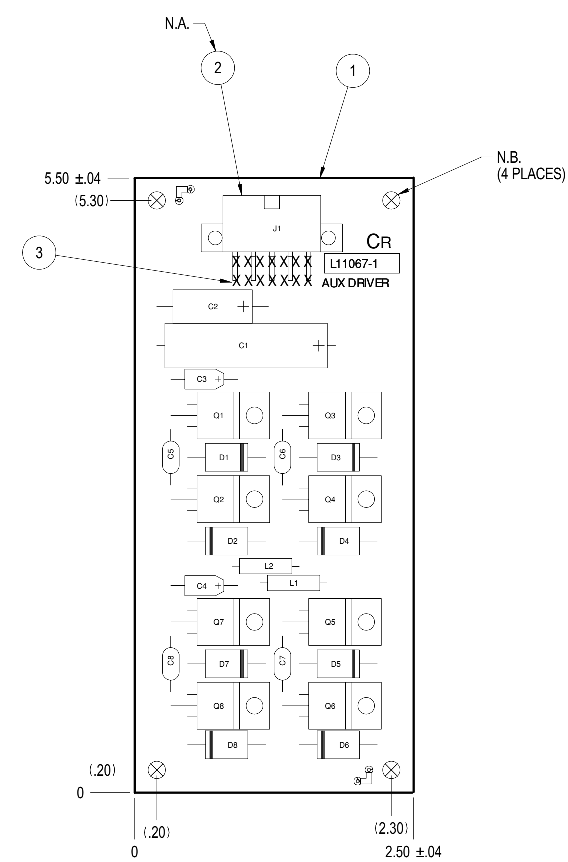
CHANGE DETAIL: RELEASED FROM X A.03

ITEM	REQ'D	PART No.	DESCRIPTION
1	1	SEE BLANK	P. C. BOARD BLANK
2	1	S24016-10	HEADER (J1)
3	1 OZ.	E2861	SEALANT

FOR ITEMS BELOW, REFER TO ELECTRONIC COMPONENTS DATABASE FOR COMPONENT SPECIFICATIONS

P.C. BOARD BLANK REFERENCE INFORMATION
MAKE FROM S19399
(MAKES 14 BOARDS PER PANEL. SEE ELECTRONIC FILE FOR ADDITIONAL INFORMATION)
BLANK PART NUMBER: L11067-C

C1	1	S13490-71	CAPACITOR,ALEL,100,50V,+75/-10%
C2	1	S13490-66	CAPACITOR,TAEL,47,35V 10%
C3,C4	2	S13490-25	CAPACITOR,TAEL,4.7,35V 10%
C5,C6,C7,C8	4	S16668-11	CAPACITOR,CEMO,0.1, 50V,10%
D1,D2,D3,D4,D5, D6,D7,D8	8	T12705-37	DIODE,AXLDS,3A,40V,SCHOTTKY
L1,L2	2	T12218-15	CHOKE,RF,FERRITE BEAD,180 OHM
Q1,Q3,Q5,Q7	4	T12704-41	TRANSISTOR,N,T220,8A,150V,MJE15030
Q2,Q4,Q6,Q8	4	T12704-49	TRANSISTOR,P,T220,8A,150V,MJE15031



UNLESS OTHERWISE SPECIFIED:
CAPACITANCE = MFD/VOLTS
INDUCTANCE = HENRIES
RESISTANCE = OHMS

MANUFACTURED AS:
L 1 1 0 6 7 - 1 C 0
PART NUMBER IDENTIFICATION CODE

MAKE PER E1911
ENCAPSULATE WITH E1844,3 TIMES
TEST PER E3826-AD

NOTES:
N.A. DO NOT COAT WITH ENCAPSULATION MATERIAL.
N.B. AFTER ENCAPSULATION, DRILL HOLES (BOTH SIDES).

UNLESS OTHERWISE SPECIFIED TOLERANCE
MANUFACTURING TOLERANCE PER E2056
ON 2 PLACE DECIMALS IS ± .02
ON 3 PLACE DECIMALS IS ± .002
ON ALL ANGLES IS ± .5 OF A DEGREE
MATERIAL TOLERANCE ("t") TO AGREE WITH PUBLISHED STANDARDS.
DO NOT SCALE THIS DRAWING

DESIGN INFORMATION
DRAWN BY: TJP
ENGINEER: TK
APPROVED: -

REFERENCE: Reference
SCALE: 1:1

EQUIPMENT TYPE: INVERTER WELDERS
SUBJECT: AUXILIARY DRIVER P.C.BD. ASSEMBLY
MATERIAL DISPOSITION: NA
APPROVAL DATE: 12/3/02
PROJECT NUMBER: CRM34209

PAGE 1 OF 1
DOCUMENT NUMBER: L11067-1
DOCUMENT REVISION: A

SOLID EDGE
EN-168
STRP

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LINCOLN ELECTRIC